SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 5
MARCH 1, 1970

W70-01642 -- W70-02042

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 5
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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02 WATER CYCLE
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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

SOLUBILITY OF CALCIUM CARBONATE PRECIPITATED IN AQUEOUS SOLUTIONS OF MAGNESIUM AND SULFATE SALTS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02K.
W70-01648

SECOND REPORT ON THERMOPHYSICAL PROPERTIES OF SALINE WATER SYSTEMS,
Monsanto Research Corp., Everett, Mass.
For primary bibliographic entry see Field 03A.
W70-01754

02. WATER CYCLE

2A. General

CLIMATE AND THE OCEAN CIRCULATION: 1. THE ATMOSPHERIC CIRCULATION AND THE HYDROLOGY OF THE EARTH'S SURFACE,
Environmental Science Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.
For primary bibliographic entry see Field 02B.
W70-01853

CLIMATE AND THE OCEAN CIRCULATION: 2. THE ATMOSPHERIC CIRCULATION AND THE EFFECT OF HEAT TRANSFER BY OCEAN CURRENTS,
Environmental Sciences Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.
For primary bibliographic entry see Field 02B.
W70-01854

CLIMATE AND THE OCEAN CIRCULATION: 3. THE OCEAN MODEL,
Environmental Science Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.
For primary bibliographic entry see Field 02B.
W70-01855

DRAINAGE DESIGN THEORY AND PRACTICE,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
E. U. Nwa, and J. G. Twocock.
J Hydrol, Vol 9, No 3, p 259-276, Nov 1969. 18 p, 10 fig, 2 tab, 15 ref.

Descriptors: *Drainage systems, *Soil water movement, *Groundwater movement, *Drainage engineering, Water management (Applied), Drainage practices, Evaluation, Design, On-site investigations, Mathematical studies, Model studies, Ditches, Drainage Programs, Agricultural engineering.
Identifiers: Drainage design theory.

Several drainage equations were chosen to compare them with the performance of an existing drainage scheme. A review of the drainage theories chosen is reported. The auger-hole method was used to determine the average hydraulic conductivity used in the calculation, and the variable drainable porosity was determined using Taylor's method. The drain discharge and the shape of the water table were determined by means of a flowmeter, and lines of piezometers, respectively. Two rainfree periods were selected for the experiment. The water table profile tends to indicate an essentially flat water surface. All the equations tested, except Luthin's, gave an average calculated spacing which is larger than the actual spacing. It is concluded that the site could perform as well as it is doing now with a wider spacing. More research is recommended before one or two equations could be chosen to aid the design of drainage schemes. (Knapp-USGS)
W70-01877

BLUEPRINT FOR A PHYSICALLY-BASED, DIGITALLY-SIMULATED HYDROLOGIC RESPONSE MODEL,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch; and Department of Fisheries and Forestry, Calgary (Alberta). Forestry Branch.
R. Allan Freeze, and R. L. Harlan.
J Hydrol, Vol 9, No. 3, p 237-258, Nov 1969. 22 p, 6 fig, 33 ref.

Descriptors: *Mathematical models, *Streamflow, *Groundwater movement, *Soil water movements, *Reviews, Rainfall-runoff relationships, Hydrology, Hydrogeology, Surface-groundwater relationships, Simulation analysis, Parametric hydrology, Synthetic hydrology, Model studies, Saturated flow, Unsaturated flow.
Identifiers: Hydrologic model studies.

Recent developments in hydrologic model studies, simulation analysis, computer models, and mathematical descriptions of flow systems are reviewed. Meaningful results are now available in the form of numerical solutions to mathematical boundary value problems for groundwater flow, unsaturated porous media flow, overland flow, and channel flow. These developments in physical hydrology, together with the tremendous advance in digital computer technology, should provide the impetus for a necessary redirection of research in hydrologic simulation. A blueprint for the development of physically-based hydrologic response models is presented; the level of sophistication that can be achieved with presently available methodology is discussed; and areas for necessary future research are pinpointed. (Knapp-USGS)
W70-01878

HYDROGEOLOGIC STUDY OF MAMORA, (FRENCH),
Morocco Geological Service, Rabat.
Jean-Pierre Thauvin.
Notes et Mem du Serv Geol Morocco, No 195, 1966. 119 p, 37 fig, 8 profiles 4 map, 45 ref, 2 append.

Descriptors: *Hydrogeology, *Geology, *Soils, *Climates, Surface waters, Groundwater, Aquifers, Water balance, Temperature, Precipitation (Atmospheric), Hydrologic data, Gaging stations, Permeability, Geophysics, Water chemistry.
Identifiers: *Morocco, Mamora.

This monograph describes the hydrogeology of the Mamora plateau, Morocco. The discussion includes: the earth (geology, geography, soil and vegetation); the water (climates, surface hydrology); hydrogeology (hydrogeologic structure of the Mamora plateau, subsurface hydraulics, the Mamora aquifers, and water balance). (Gabriel-USGS)
W70-01911

2B. Precipitation

RAINFALL PATTERNS ON THE KAWEKA RANGE,
Ministry of Works, Napier (New Zealand). Water and Soil Div.
P. J. Grant.
J Hydrol (New Zeal), Vol 8, No 1, p 17-34, 1969. 18 p, 8 fig, 7 tab, 17 ref, 1 append.

Descriptors: *Rainfall disposition, *Topography, *Distribution patterns, Rainfall, Statistical methods, Sampling, Rain gages, Rainfall-runoff relationships, Data collections.
Identifiers: *New Zealand, Kaweka Range (New Zeal).

Rainfall patterns are based on records from 17 storage rain gages in the rangeland area, and from daily rain-gage stations surrounding the Kaweka Range, New Zealand. Correlations between storage and daily reference stations, using rainfall amounts for corresponding periods, determined the affinities of the storage stations and indicated that three distinct directional influences exist. In relation to the Kaweka Range these are recognized as the N, SW, and SE regimes or sectors. Annual rainfalls attain about 150 in. in the highest part of the range. For a given altitude rainfall totals are lower in the northern area than on the southern Kaweka Range. The SW sector is the least variable--about 10%. The seasonal and monthly patterns of rainfall are presented as percentages of annual norms, and it is shown how approximate seasonal or monthly values may be derived for any rangeland area. (Knapp-USGS)
W70-01686

A NOTE ON RANDOM RAIN-GAUGE ERRORS,
Otago Univ., Dunedin (New Zealand).
For primary bibliographic entry see Field 07A.
W70-01693

RAINFALL PATTERNS IN THE CENTRAL NEGEV DESERT,
National and Univ. Inst. of Agriculture, Rehovoth (Israel).
L. Shanan, M. Evenari, and N. H. Tadmor.
Israel Exploration Journal, Vol 17, No 3, 1967, p 163-184. 3 tab, 13 fig, 28 ref.

Descriptors: *Rainfall, *Variability, *Dendrochronology, *Climatic data, *Arid lands, Rainfall intensity, Frequency, Cycles, Forecasting, Precipitation (Atmospheric), Growth rate, Plant growth, Annual, Monthly.
Identifiers: *Israel, *Negev Desert, Beersheba, Climatic cycles, Intensity-duration.

The study reported here is concerned with rainfall variability and its impact on agriculture in the Negev Desert in southern Israel. Rainfall in the Negev occurs only in the winter months. It was found that the 45 year span of rainfall records at Beersheba were representative of all other stations in the Negev. Dendrochronological studies showed that annual growth of Zygophyllum dumosum correlated with rainfall at Beersheba. Thus, a 250 year rainfall record was derived. Annual Negev highland rainfall was found to have fluctuated near a mean of 86 mm with a cyclic variation of 28 mm every 50 years. 50 years of above average precipitation were followed by 50 years below average. Fluctuations and trends are in turn correlated with world wide climatic trends as indicated by temperature change, sea level changes, and sunspot activity. Results of the study suggest that additional dendrochronological studies would be useful for predicting trends in the million ha. Negev region. (Crouse-Arizona)
W70-01815

THE 'EL NINO' PHENOMENON AND RAINFALL IN PERU AND ECUADOR,
Texas A and M Univ., College Station. Dept. of Meteorology; and Texas A and M Research Foundation, College Station.
For primary bibliographic entry see Field 03B.
W70-01816

THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT. STATISTICAL EVALUATION FOR THE PERIOD 1961-65,
Hebrew Univ., Jerusalem (Israel).
For primary bibliographic entry see Field 03B.
W70-01821

CLIMATE AND THE OCEAN CIRCULATION: 1. THE ATMOSPHERIC CIRCULATION AND THE HYDROLOGY OF THE EARTH'S SURFACE,
Environmental Science Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.

Syukuro Manabe.
Monthly Weather Rev, Vol 97, No 11, p 739-774, Nov 1969. 36 p, 55 fig, 49 ref, append.

Descriptors: *Climatology, *Ocean circulation, *Mathematical models, Ocean currents, Weather, Heat budget, Heat balance, Hydrology, Water temperature, Hydrologic budget, Hydrologic cycle, Atmospheric physics.
Identifiers: General atmospheric circulation model.

The effect of the hydrology of the earth's surface is incorporated into a numerical model of the general circulation of the atmosphere, using the primitive equation of motion. The nine levels of the model are distributed so as to resolve the surface boundary layer and stratosphere. The depletion of solar radiation and the transfer of the terrestrial radiation are computed taking into consideration cloud and atmospheric absorbers such as water vapor, carbon dioxide, and ozone. The scheme involves the prediction of water vapor in the atmosphere and the prediction of soil moisture and snow cover. In order to represent the moisture-holding capacity of soil, the continent is assumed to be covered by boxes, which can store limited amounts of water. The ocean surface is idealized to be a completely wet surface without any heat capacity. The temperature of the earth's surface satisfies the condition of heat balance. The horizontal distribution of rainfall is in excellent qualitative agreement with the observations. Some features of the spatial distributions of heat and water balance components at the earth's surface also agree well with those obtained by Budyko for the actual atmosphere. (Knapp-USGS)
W70-01853

CLIMATE AND THE OCEAN CIRCULATION: 2. THE ATMOSPHERIC CIRCULATION AND THE EFFECT OF HEAT TRANSFER BY OCEAN CURRENTS,
Environmental Sciences Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.
Syukuro Manabe.
Monthly Weather Rev, Vol 97, No 11, p 775-805, Nov 1969. 31 p, 54 fig, 1 tab, 22 ref.

Descriptors: *Climatology, *Ocean circulation, *Mathematical models, Ocean currents, Weather, Heat budget, Heat balance, Hydrology, Water temperature, Hydrologic budget, Hydrologic cycle, Atmospheric physics, Evaporation.
Identifiers: General atmospheric circulation model.

A general circulation model of the joint ocean-atmosphere system is constructed by combining an ocean model and an atmospheric model. The quantities exchanged between the oceanic part and the atmospheric part of the joint model are momentum, heat, and water. Integration of the atmospheric part yields the surface wind stress, net radiation, sensible heat flux, rates of rainfall and snowfall, rates of evaporation and sublimation, and rates of runoff and iceberg formation, all of which constitute the upper boundary conditions for the oceanic part of the model. From the oceanic part, the thickness of ice and the distribution of sea-surface temperature, which constitute the lower boundary conditions for the atmospheric part of the model, are computed. Since the thermal relaxation time of the oceanic part of the model is much longer than that of the atmospheric part, a special technique for economizing the computation time is developed. A detailed analysis of the final solution at the end of the integration is carried out. According to this analysis, the distributions of various heat balance components such as radiation flux and the turbulent flux of sensible and latent heat compare favorably with the corresponding distributions in the actual atmosphere. It is possible to identify the effect of an ocean circulation on the general circulation of the atmosphere. (Knapp-USGS)
W70-01854

CLIMATE AND THE OCEAN CIRCULATION: 3. THE OCEAN MODEL,
Environmental Science Services Administration, Princeton, N.J. Geophysics Fluid Dynamics Lab.
Kirk Bryan.
Monthly Weather Rev, Vol 97, No 11, p 806-827, Nov 1969. 22 p, 18 fig, 6 tab, 28 ref.

Descriptors: *Climatology, *Ocean circulation, *Mathematical models, Ocean currents, Weather, Heat budget, Heat balance, Hydrology, Water temperature, Hydrologic budget, Hydrologic cycle, Atmospheric physics, Evaporation.
Identifiers: General atmospheric-oceanic model.

An ocean model used in a calculation of the earth's climate is described in detail. Temperature and salinity are treated separately. Density is calculated with an accurate equation of state for sea water. The model also includes a method for calculating the growth and movement of sea ice. Due to the very slow adjustment of the deep water in the ocean model, a numerical integration extending over the equivalent of a century fails to reach a climatic equilibrium. At the termination of the run, the surface layers of the ocean show little change with respect to time, but the average heating rate for the ocean as a whole is 2 deg per century. The salinity patterns at the termination of the run are highly realistic compared to observations. The calculation indicates that the thermal 'relaxation' time of the ocean is too long for a numerical integration of the time-dependent equations to be a practical method of finding an equilibrium solution, and new methods should be sought for future calculations of this type. (Knapp-USGS)
W70-01855

A PRELIMINARY STUDY OF STORM MAXIMIZATION BY MOISTURE CHARGE METHOD,
Institute of Tropical Meteorology, Poona (India).
O. N. Dhar, and P. R. Mhaiskar.
Indian J Meteorol and Geophys, Vol 19, No 4, p 427-430, Oct 1968. 4 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Storms, *Design storm, *Rain, *Moisture, Moisture availability, Surveys, Mapping, Seasonal, Rainfall, Dew, Floods, Design flood, Distribution patterns, Meteorology.
Identifiers: *India, Maximum rainstorm.

Calculation of maximum rainstorms by moisture charge has been attempted for the southern half of the Indian Peninsula from Latitude 8 deg N to about Latitude 12 deg N. The use of the moisture charge method is based on the following assumptions: the rainfall can be expressed as the product of available moisture, storm efficiency, and inflow wind; the most effective combination of storm efficiency and inflow wind has been closely approached in the major storms recorded in the area. The average maximization factors range from 2 to 26% and these are generally low during the months of October to December. (Gabriel-USGS)
W70-01864

A BRIEF STUDY OF RAINFALL AND SPILLWAY DESIGN STORM FOR THE GODAVARI BASIN UP TO PAITHAN DAM SITE,
Institute of Tropical Meteorology, Poona (India).
O. N. Dhar, P. R. Mhaiskar, and G. C. Ghose.
Indian J Meteorol and Geophys, Vol 19, No 4, p 413-420, Oct 1968. 8 p, 6 fig, 4 tab, 1 ref.

Descriptors: *Rainfall, *Design storm, *Design criteria, Dams, River basins, Variability, Lakes, Rivers, Mapping, Monsoons, Seasonal, Frequency analysis, Statistical methods.
Identifiers: *India, Spillway design rainstorm.

Mean monthly and annual rainfall data for the Godavari basin up to the Paithan damsite, India, were analyzed using the isohyetal method. Seventy three heaviest rain spells in the 1891-1963 period were analyzed by means of the depth-duration method, as well as by Gumbel's statistical method. The mean annual rainfall is about 29 inches and the coefficient of variability is the highest in the central part of the Godavari River basin, about 40 to 44% for monsoon rainfalls. (Gabriel-USGS)
W70-01865

RESULT OF CLOUD SEEDING EXPERIMENT AT DELHI AS ASSESSED BY RADAR,
Inst. of Tropical Meteorology, Poona (India).
For primary bibliographic entry see Field 03B.
W70-01876

THE DIFFERENCE BETWEEN RAINFALL AND POTENTIAL EVAPORATION IN FLORIDA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02D.
W70-01881

A STUDY OF CLIMATOLOGICAL AND OTHER RAINFALL PATTERNS OVER CENTRAL INDIA,
Regional Meteorological Center, Nagpur (India).
V. C. Bedekar, and A. K. Banerjee.
Indian J Meteorol and Geophys, Vol 20, No 1, p 23-30, Jan 1969. 8 p, 8 fig, 4 ref.

Descriptors: *Climates, *Rainfall, *Rain, *Rainfall disposition, Seasonal, Monsoons, Forecasting, Altitude, Rain gages, Instrumentation, Mapping, Streamflow, Distribution patterns.
Identifiers: *Central India.

A study of rainfall patterns in central India consists of the normal monthly rainfall charts during the monsoon months for the Madhya Pradesh and Vidarbha areas; the spatial distribution of rainfall associated with monsoon depressions moving across Central India; and the character of rainfall at different places in and around a low-level convergence zone occurring over the above area. The use of self-recording raingage charts for local forecasting is also discussed. (Gabriel-USGS)
W70-01887

A PILOT STUDY FOR THE ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION USING HERSHFIELD TECHNIQUE,
Institute of Tropical Meteorology, Poona (India).
O. N. Dhar, and P. P. Kamte.
Indian J of Meteorol and Geophys, Vol 20, No 1, p 31-34, Jan 1969. 4 p, 1 fig, 3 tab, 6 ref.

Descriptors: *Probable maximum precipitation, *Precipitation intensity, *Analytical techniques, Statistical methods, Probability, Rainfall, Frequency, Gaging stations, Mapping, Meteorological data.
Identifiers: *India, Uttar Pradesh.

A statistical technique developed by D. M. Hershfield (1961) is applied for the determination of one-day probable maximum precipitation for the plain areas of Uttar Pradesh using daily rainfall data from 230 stations. A generalized chart of probable maximum precipitation (PMP) based on these recorded data shows that in this region one-day PMP values obtained by this technique are 2 to 4 times the highest observed one-day rainfall during the past 60 to 70 years. (Gabriel-USGS)
W70-01888

MAJOR TEMPERATURE CHARACTERISTICS OF WATER IN THE WEST-CENTRAL PART OF THE CASPIAN SEA (IN AZERBAIDZHAN),
T. Kh. Zulfugarov.
Summary in Russian. Izvestiya Akademii Nauk, Azerbaidzhanskoi, SSSR, Seriya Fiziki Zemli, No 6, p 91-96, 1968. 2 fig, 2 tab, 4 ref.

Descriptors: *Surface waters, *Water temperature, *Seashores, *Sea water, Gaging stations, Hydrologic data, Meteorological data, Seasonal, Ice, Icebergs.
Identifiers: *USSR, Caspian Sea.

A brief history of investigations on the effect of various hydrometeorological parameters on sea water temperature and on the mean annual and monthly temperature values at several hydrometeorological stations is presented. The mean annual water temperature in the western and southern parts of the Central Caspian Sea is 12.5-12.6 deg C and 14.8-15.0 deg C respectively. Dur-

ing cold periods the water temperature difference is 415 deg and during the warm periods this difference does not exceed 1 to 2 deg. Effect of ice and icebergs on the water temperature is disscussed. (Gabriel-USGS)
W70-01910

2C. Snow, Ice, and Frost

GLACIER DRAINAGE CONNECTED WITH ICE STRUCTURES,
Uppsala Univ. (Sweden). Dept. of Physical Geography.
Thorsten Stenborg.
Geogr Ann, Vol 50, No 1, Ser A, p 25-53, 1968. 29 p, 22 fig, 7 tab, 60 ref.

Descriptors: *Runoff, *Glaciers, *Drainage, Ablation, Melting, Ice, Karst, Sediments, Melt water, Regimen.
Identifiers: *Sweden, *Mikkaglaciaren, Glacial drainage, Ice structures.

Systematic observations on Mikkaglaciaren in northern Sweden are presented and a general discussion is given concerning drainage connected with structures in the upper layer of a glacier. The basic conditions (surface drainage and structural pattern) for this drainage are first analyzed. A series of observations on 'drainage structures' during a five-year period is presented and reproduced on a map. Descriptions and comments are given as to the formation and further development of observed glacier mills and related features, with regard to local environmental characteristics and to the time factor involved. (Knapp-USGS)
W70-01702

2D. Evaporation and Transpiration

THE PREDICTION OF EVAPORATION, DRAINAGE, AND SOIL WATER STORAGE FOR A BARE SOIL,
Wisconsin Univ., Madison. Dept. of Soil Sciences.
For primary bibliographic entry see Field 02G.
W70-01664

EVAPORATION COEFFICIENT OF LIQUIDS,
Rochester Inst. of Tech., N.Y.
For primary bibliographic entry see Field 03A.
W70-01759

EVAPORATION FROM BARE SOIL UNDER HIGH RADIATION CONDITIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
C. W. Rose.
9th International Congress of Soil Science, Adelaide, Australia, 1968, Transactions, Vol 1, p 57-66. 10 p, 1 tab, 12 ref.

Descriptors: *Evaporation, *Solar radiation, *Arid lands, *Meteorological data, *Soil water movement, Energy budget, Soil water, Temperature, Soil temperature, Soil profiles, Soil physical properties, Moisture content, Equations.
Identifiers: *Australia, *Vapor flux, *Water transport, Vapor phase, Liquid phase.

The theory of Penman or Ferguson for predicting rate of evaporation from meteorological data is completely inapplicable when evaporation is limited by water transport in soil. Such conditions are common in arid lands with high levels of radiation. This paper presents a theory that enables evaporation from bare soil to be calculated from water content and temperature profiles. The theory was tested on an experimental site near Alice Springs, Australia. Evaporation over any time period is equated to the sum of upward liquid and vapor phase water fluxes at any depth in the soil and decrease in water stored in soil to that depth over the same interval. Vapor phase transport was found to be very important under conditions of bare soil and high evaporative potential. (Crouse-Arizona)
W70-01818

MOISTURE CONDENSATION ON WINTER VEGETATION,
Arizona Univ., Tucson. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02I.
W70-01835

THE DIFFERENCE BETWEEN RAINFALL AND POTENTIAL EVAPORATION IN FLORIDA,
Geological Survey, Washington, D.C.
F. N. Visher, and G. H. Hughes.
Florida Dep Natur Resources, Bur Geol Map Ser No 32, Aug 1969. 1 sheet, 1 fig, text, 1 map, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Evaporation, *Florida, Hydrologic budget, Water balance, Climatology, Synoptic analysis, Regional analysis, Streamflow, Streamflow forecasting, Hydrologic data.
Identifiers: Evaporation-rainfall relationships (Fla).

Rainfall-potential evaporation differences in Florida are computed and shown by a contour map. The areal distribution of potential evaporation was taken from published sources. Rainfall data were compiled from U.S. weather Bureau records. Average rainfall ranges from about 46-66 inches annually, and estimated evaporation ranges from about 54-46 inches. The difference between rainfall and evaporation ranges from about 18 inches in the northwest to about zero in the southwest. (Knapp-USGS)
W70-01881

2E. Streamflow and Runoff

YIELD OF STREAMS IN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
G. R. Higgins.
Mass Univ Water Resources Res Center Interim Rep, Mar 1967. 175 p, 14 fig, 4 tab, 20 ref, 4 append. OWRR Proj No A-003-MASS.

Descriptors: *Water yield, *Streamflow, *Massachusetts, *Hydrologic data, *Data collections, Droughts, Runoff, Hydrographs, Duration curves, Frequency analysis, Water storage, Climates, Precipitation (Atmospheric).
Identifiers: Storage-yield curves.

Results of studies on the yield of gaged streams in Massachusetts are summarized. Additional material includes introduction of computer methods for determining yield values and extension of the data. Data and comments concerning the recent drought in the Northeast and description of current research projects are introduced. A discussion of results to date and recommendations for future studies are also included. Runoff for the last five years has been extremely low and there are many who feel that the current drought is one of very rare occurrence. Design data including these years may be unrealistic. (Knapp-USGS)
W70-01700

THE RECENT HISTORY OF THE INDUS,
Hunting Technical Services Ltd., Boreham Wood (England).
For primary bibliographic entry see Field 07B.
W70-01804

BLUEPRINT FOR A PHYSICALLY-BASED, DIGITALLY-SIMULATED HYDROLOGIC RESPONSE MODEL,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch; and Department of Fisheries and Forestry, Calgary (Alberta). Forestry Branch.
For primary bibliographic entry see Field 02A.
W70-01878

SEASONAL VARIATION OF STREAMFLOW IN FLORIDA,
Geological Survey, Washington, D.C.
W. E. Kenner.
Florida Dep Natur Resources, Bur Geol Map Ser No 31, July 1969. 1 sheet, 2 fig, 1 map.

Descriptors: *Streamflow, *Regional analysis, *Climatology, *Florida, Climatic data, Hydrologic data, Runoff, Rainfall-runoff relationships, Base flow, Aquifers, Rainfall, Seasonal, Wet seasons.
Identifiers: Seasonal streamflow variation (Fla).

Data on the seasonal variation of streamflow of 10 Florida rivers are compiled and shown by graphs. Florida's pattern of streamflow variation is unusual in two respects. First, the month-to-month variation in average streamflow is relatively small; second, the seasonal variations of streams in different sections of the state are different. The small month-to-month variability in streamflow is the result of (1) the relatively low variability of average monthly rainfall; (2) the relatively high rate of evapotranspiration in the summer; (3) the large volume of slowly released natural storage in Florida's numerous lakes; and (4) the large and relatively stable inflow of groundwater to streams from extensive limestone and alluvial aquifer systems. Florida's unusual pattern of seasonal variation of streamflow is due largely to its position in the transition zone between the continental weather pattern of southeastern United States and the tropical weather pattern of the Caribbean Sea. During the winter and early spring the continental pattern predominates in northern Florida. Florida's summer and fall climate is sub-tropical and is characterized by local thunderstorms. The line of demarcation between areas dominated by the two weather types is not sharp. The continual north-south shifting of the tropical and continental air masses results in a seasonal distribution of rainfall that has a predominantly continental pattern in northwestern Florida, is less continental and more tropical in central Florida, and is predominantly tropical in southern Florida. (Knapp-USGS)
W70-01880

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 6. MISSOURI RIVER BASIN.
Geological Survey, Washington, D.C.

Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402. Geol Surv Water-Supply Pap 1919, 1969. 805 p, 1 fig, 1 plate, index.

Descriptors: *Data collections, *Surface waters, *Streamflow, *Missouri River, *Nebraska, Missouri, Kansas, Colorado, Iowa, Stream gages, Lakes, Reservoirs, Stage-discharge relations, Water temperature.
Identifiers: Surface water records, Water resources data, Missouri River Basin.

The surface-water records for the 1961-65 water years for gaging stations, partial-record stations, and miscellaneous sites in the Missouri River basin are presented. The data generally comprise a description of the station and a table showing the daily discharge and monthly and yearly discharge of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. The type of gage currently in use and the datum of the gage above mean sea level, and a condensed history of the

types, locations, and datums of previous gages used during the period of records available are listed. Information on the accuracy of the records and conditions which affect the natural flow is given under 'Remarks.' Daily discharges, average discharge, extremes, yearly totals, and peak discharges are listed in a table. (Knapp-USGS)
W70-01884

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART 6. MISSOURI RIVER BASIN.
Geological Survey, Washington, D.C.

Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402. Geol Surv Water-Supply Pap 1918, 1969. 751 p, 1 fig, 1 plate, index.

Descriptors: *Data collections, *Surface waters, *Streamflow, Hydrologic data, Missouri River, Stream gages, Lakes, Reservoirs, Stage-discharge relations, Discharge (Water).
Identifiers: *Surface water records, *Missouri River basin, Water resources data.

The surface-water records for the water years 1961-65 for gaging stations, partial-record stations, and miscellaneous sites in the Missouri River basin are presented. The data generally comprise a description of the station and a table showing the daily discharge and monthly and yearly discharge of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. The type of gage currently in use and the datum of the gage above mean sea level, and a condensed history of the types, locations, and datums of previous gages used during the period of records available are listed. Information on the accuracy of the records and conditions which affect the natural flow is given under 'Remarks.' Daily discharges, average discharge, extremes, yearly totals, and peak discharges are listed in a table. (Knapp-USGS)
W70-01885

NATIONAL INVENTORY OF SURFACE WATER RESOURCES - VOLUME 1,
Ministry of Public Works, Caracas (Venezuela).
Alfredo Lopez.
Repub of Venezuela, Comm for Nat Plan of Water Develop Spec Publication, Feb 1969. 34 p, 3 tab, 6 ref, append.

Descriptors: *Data collections, *Hydrologic data, *Surface waters, *Surveys, Runoff, Streamflow, Precipitation (Atmospheric), Water resources development, Climates, Hydrography.
Identifiers: *Venezuela, Surface water inventory.

An inventory of the surface water resources data of Venezuela includes information on streamflow, water quality, and water availability. A mean annual isohyetal map, a mean annual isothermic map, a nationwide estimate of evapotranspiration, and mean national runoff volume were prepared. Regional mean annual runoff values are tabulated. Major rivers and their annual flows are listed. (Knapp-USGS)
W70-01889

A STUDY OF THE PHYSICAL HYDROGRAPHY OF THE PATUXENT RIVER AND ITS ESTUARY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 02L.
W70-01890

AERIAL INFRARED SURVEYS AT THE GEYSERS GEOTHERMAL STEAM FIELD, CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-01894

DRAINAGE DENSITY AS AN INDICATOR OF BASE FLOW IN PART OF THE POTOMAC RIVER BASIN,
Geological Survey, Washington, D.C.
Frank W. Trainer.
In: Geol Surv Res 1969, Prof Pap 650-C, p C177-C183, 1969. 7 p, 4 fig, 2 tab, 11 ref.

Descriptors: *Base flow, *Drainage density, Runoff, Streamflow, Hydrographs, Hydrograph analysis, Stream gages, Streamflow forecasting, Hydrogeology, Mapping.
Identifiers: Drainage density-base flow relations.

The base flow from 10 stream basins in an area of 1,900 square miles in the Piedmont and Blue Ridge provinces in Pennsylvania, Maryland, and Virginia, as determined by hydrograph separation, is inversely proportional to drainage density. This relationship was used to estimate the base flow from ungaged basins in the area. Streamflow records from two gages on the Potomac River, also studied by hydrograph separation, define the contribution of the entire area to the discharge of the river and provide a check on the estimate made by drainage density. For a 1-year period the estimate of base flow from the ungaged basins, made by the use of drainage density, is within 45% of the estimate from hydrograph separation. This agreement suggests that drainage density will be useful in hydrogeologic mapping and in planning streamflow measurements for the study of base flow. (Knapp-USGS)
W70-01896

2F. Groundwater

ARTIFICIAL RECHARGE TO THE SNAKE PLAIN AQUIFER IN IDAHO; AN EVALUATION OF POTENTIAL AND EFFECT,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-01654

GEOLOGICAL AND HYDROGEOLOGICAL RESEARCH IN THE WESTERN PART OF THE GETIC DEPRESSION (RUMANIAN),
Emil Liteanu, Mircea Feru, Mihai Croitoru, Natalia Golita, and Eugen Golita.
Studii Tehnice si Economice, Seria E, Hidrogeologie, No 7, Studii de Hidrogeologie, p 7-58, 1967. 4 fig, 6 tab, 39 ref. Summaries in English and French.

Descriptors: *Hydrogeology, *Aquifers, *Hydrologic properties, Geology, Boreholes, Artesian wells, Water supply, Coals, Hydrostatic pressure, Altitude, Discharge (Water), Water sources, Chemical analysis.
Identifiers: Rumania, Getic depression.

Geological and hydrological conditions of the Getic depression were investigated by using geological, geochemical, and hydrological observations. The surface rocks of the depression are of Pliocene and Quaternary age. Several aquifers separated by coal beds are under pressure varying from 3.7 to 1.2 atm. It is believed that these artesian aquifers are well suited for agricultural or industrial uses. (Gabriel-USGS)
W70-01655

ARTIFICIAL GROUNDWATER RECHARGE - WET WALNUT CREEK,
Geological Survey, Lawrence, Kans. Water Resources Div.; and Kansas Water Resources Board, Topeka.
For primary bibliographic entry see Field 04B.
W70-01659

GEOLOGY AND GROUND WATER RESOURCES OF BURKE AND MOUNTRAIL COUNTIES: PART 2, GROUND WATER BASIC DATA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-01684

GEOLOGY AND GROUND WATER RESOURCES OF WILLIAMS COUNTY, NORTH DAKOTA: PART 3 - HYDROLOGY,
Geological Survey, Washington, D.C.
C. A. Armstrong.
N Dak Geol Surv Bull 48 and N Dak State Water Comm County Ground Water Studies 9, 1969. 82 p, 22 fig, 2 plate, 2 tab, 34 ref.

Descriptors: *Water resources, *Groundwater, *North Dakota water wells, Hydrologic data, Data collections, Aquifers, Water quality, Water yield, Water levels, Water Supply, Recharge, Permeability.
Identifiers: *Williams County (N Dak).

Groundwater in Williams County, North Dakota, is obtained from aquifers in the glacial drift of Quaternary age, the Fort Union Group of Tertiary age, and the Dakota Group of Cretaceous age. Three of the more productive aquifers are the Little Muddy, Ray, and Grenora; these aquifers are composed of sand and gravel that was deposited in the ancestral Yellowstone, Little Missouri, and Missouri River valleys, respectively. Properly constructed wells in the more permeable parts of these glacial aquifers can be expected to yield more than 500 gallons per minute. Yields of more than 500 gpm are also obtainable from the more permeable parts of the Trenton and Hofflund aquifers in the proglacial Yellowstone and Missouri River valleys. Yields of 50 to 500 gpm are obtainable from some outwash and buried glaciofluvial deposits in the northern part of the county and from some of the finer sand deposits in the 5 major aquifers. Water from the glacial drift aquifers differs greatly in quality. Generally it is very hard and of a calcium bicarbonate type. Water in the Fort Union Group consists of 2 types; a soft sodium bicarbonate water, and a hard sodium sulfate bicarbonate water. Generally it is too saline for human consumption or irrigation. Water from the Dakota is used for pressure maintenance in oil fields, but is too saline for most other uses. (Knapp-USGS)
W70-01685

OBSERVATIONS OF THE PRESSURE SURFACE IN THE AQUIFER OF AN IRRIGATION DISTRICT AT MERBEIN, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Merbein (Victoria). Div. of Horticultural Research.
J. Groot Obbink.
J Hydrol, Vol 9, No 3, p 294-306, Nov 1969. 13 p, 6 fig, 3 tab, 8 ref.

Descriptors: *Water levels, *Aquifers, *Irrigated land, *Irrigation effects, Water level fluctuations, Saturated soils, Water table, Groundwater movement, Piezometers, Hydrogeology, Sands.
Identifiers: *Australia, Merbein (Victoria).

To observe the pressure surface in the aquifer in the Merbein Irrigation District, which is situated on the River Murray in Northwest Victoria, one piezometer was installed in 1952 and a further nine piezometers were installed in 1960. The aquifer is a Post-Tertiary water bearing sand located at depths ranging from 14 to 75 ft from the surface. The bedrock, consisting of paleozoic rock, is estimated to be about one thousand feet below the soil surface. Location of piezometers and depth of the aquifer below soil surface at each piezometer site are given. Information obtained over a period of eight years has shown that the pressure surface is not constant but in general has risen, although at different rates for each piezometer site. The increases ranged from 0.35 ft to 2.49 ft, while one piezometer site has shown a decrease of 1.25 ft. The pressure surface in the piezometer installed in 1952 has risen by 5.29 ft over a period of 15 years. The rise of pressure surface, the direction of flow, the quality of the water in the aquifer and the potential danger for certain low-lying areas are discussed. (Knapp-USGS)
W70-01857

THE USE OF SCHLUMBERGER AND EQUATORIAL SOUNDINGS IN GROUNDWATER INVESTIGATIONS NEAR EL PASO, TEXAS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07B.
W70-01859

BLUEPRINT FOR A PHYSICALLY-BASED, DIGITALLY-SIMULATED HYDROLOGIC RESPONSE MODEL,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch; and Department of Fisheries and Forestry, Calgary (Alberta). Forestry Branch.
For primary bibliographic entry see Field 02A.
W70-01878

BASE FLOW WELLS: RIO COBRE PROJECT, JAMAICA,
Humphreys (Howard) and Sons, Reading (England); and Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 04B.
W70-01891

GROUND-WATER INFLOW TOWARD JORDAN VALLEY THROUGH CHANNEL FILL IN SEVEN CANYONS IN THE WASATCH RANGE NEAR SALT LAKE CITY, UTAH,
Geological Survey, Salt Lake City, Utah.
R. W. Mower.
In: Geol Surv Res 1969, Prof Pap 650-C, p C174-C176, 1969. 3 p, 2 fig, 1 tab, 4 ref.

Descriptors: *Groundwater movement, *Inflow, *Alluvium, *Alluvial channels, *Utah, Hydraulic conductivity, Transmissivity, Recharge, Discharge (Water), Water levels, Water table, Underflow, Groundwater basins.
Identifiers: Wasatch Range, Salt Lake City (Utah).

The estimated quantity of underflow moving toward the Jordan Valley in the channel fill of 7 major canyons in the Wasatch Range near Salt Lake City, Utah, is 3,400 acre-feet of water per year. About 2,000 acre-feet of this water is discharged by springs and wells before it reaches the principal groundwater reservoir in the valley, leaving about 1,400 acre-feet per year available for recharge. About 93% of the recharge is from Little Cottonwood Creek Canyon and 7% from the other 6 canyons. (Knapp-USGS)
W70-01895

HYDROGEOLOGIC RECONNAISSANCE OF THE CANARY ISLANDS, SPAIN,
Geological Survey, Lawrence, Kan.; and Ministry of Public Works (Canary Islands).
Robert J. Dingman, and Jose Nunez.
In: Geol Surv Res 1969, Prof Pap 650-C, p C201-C208, 1969. 8 p, 3 fig, 3 tab, 7 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Water resources development, *Surveys, Hydrogeology, Water wells, Water yield, Aquifers, Water levels, Water level fluctuations.
Identifiers: Canary Islands.

The Canary Islands are a group of volcanic islands off the west coast of Africa. Rainfall is sparse, and groundwater is used to support an agricultural economy. On the major islands overpumpage occurs and water levels are lowering rapidly. (Knapp-USGS)
W70-01901

CARBON-14 DATES OF GROUND WATER FROM A PALEOZOIC CARBONATE AQUIFER, SOUTH-CENTRAL NEVADA,
Geological Survey, Denver, Colo.; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-01903

GEOCHEMISTRY OF IRON IN A COASTAL-PLAIN GROUND WATER OF THE CAMDEN, NEW JERSEY, AREA,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02K.
W70-01905

GEOLOGICAL AND HYDROGEOLOGICAL OBSERVATIONS IN THE TIRGUL SECUIESC ZONE (ROMANIAN),
Bucharest Inst. of Geology (Rumania).
T. Bandrabur.
Summaries in English and French, Romania, Institutul Geologic, Studii Tehnice si Economice, Seria E, Hidrogeologie No 7, Studii de Hidrogeologie, p 87-103, 1967. 1 fig, 2 tab, 13 ref.

Descriptors: *Water chemistry, *Hydrogeology, *Geology, *Aquifers, Quaternary period, River basins, Water analysis, Chlorine, Sodium, Calcium, Magnesium, Carbonates, Sulfates, Water quality.
Identifiers: *Romania, Tirgul Secuiesc Zone.

Hydrogeology and morphology of the Tirgul Secuiesc Zone, Romania was investigated on the basis of hydrogeological and geochemical studies. Groundwaters of the zone are characterized by mineral contents of 0.450 to 1.600 gr/Kg; however some highly mineralized waters have 2.0-6.0 gr/Kg contents. Fresh water as well as the mineralized waters of the zone belong to five hydrochemical groups as follows: calcium-magnesium bicarbonates; sodium-carbon dioxide-bicarbonates; calcium-chlorine bicarbonates; calcium sulfates; and calcium chlorides. (Gabriel-USGS)
W70-01906

HYDROGEOLOGICAL RESEARCH IN THE DANUBE DELTA (ROMANIAN),
State Geological Committee, Bucharest (Rumania).
E. Liteanu, A. Pricajan, and Maria Mocanu.
Summaries in English and French, Romania Institutul Geologic, Studii Tehnice si Economice, Seria E, Hidrogeologie No 7, Studii de Hidrogeologie, p 59-86, 1967. 1 fig, 3 plate, 7 tab, 8 ref.

Descriptors: *Hydrogeology, *Aquifers, *Deltas, Geology, Quaternary period, Salinity, Underground streams, Discharge (Water), Potable water, Paleozoic era, Mesozoic era, Water chemistry, Calcium, Magnesium, Iron, Chlorine, Ions.
Identifiers: Danube delta.

The presence and distribution of aquifers in the Danube delta was investigated on the basis of geological, hydrological, and geochemical data. Water bearing strata can be found in both the Quaternary basement and deltaic sediments. The aquifers of the basement formations generally have a high mineral content and are of no practical value. The deltaic deposits are characterized by the presence of groundwater flows and can be well utilized, especially the western zone where good drinking water of high discharge is observed. Groundwaters located in the marine delta zone cannot be utilized because of their high salinity content. (Gabriel-USGS)
W70-01907

ORIGIN OF THE MINERALIZATION OF THE PHREATIC WATERS IN THE BUZAU-RIMNICUL SARAT INTERFLUVIAL PLAIN (ROMANIAN),
Babes-Bolyai Univ., Cluj (Rumania).
P. Marosi.
English summary. Romania Institutul Geologic, Studii Tehnice si Economice, Seria E, Hidrogeologie, No 7, Studii de Hidrogeologie, p 105-147, 1967. 8 fig, 8 plate, 4 tab, 33 ref.

Descriptors: *Hydeogeology, *Aquifers, *Mineral water, Climates, Dry seasons, Salinity, Geology, Streamflow, River basins, Water chemistry, Water analysis, Ions, Iron, Sodium, Calcium, Magnesium, Potassium, Sulfates.
Identifiers: *Romania, Buzau-Rimnicul Sarat.

The hydrogeology and hydrochemistry of the Buzau-Rimnicul Sarat area, Romania are discussed. The position of phreatic waters corresponds to the law of hydrogeological zones characterized by the piemontane accumulative structures where, under the effect of dry climate, the hydrochemical zone of the phreatic waters is formed due to the effect of continental salinization processes. The position and the salinity zone of the phreatic water are affected to a large extent by the waters of the Rimnicul Sarat River which penetrates the phreatic horizon. The study separates the area into several districts characterized by their peculiar mineralization, such as phreatic, fluvial, lacustrine, etc. (Gabriel-USGS)
W70-01908

HYDROGEOLOGICAL RESEARCH IN THE BARAOLT BASIN (ROMANIAN),
Gh. Vasilescu, and Neonila Avramescu.
French summary. Romania, Institutul Geologic, Studii Tehnice si Economice, Seria E, Hidrogeologie, No 7, Studii de Hidrogeologie, p 151-171, 1967. 3 plate, 1 tab, 4 ref.

Descriptors: *Hydrogeology, *River basins, *Aquifers, Boreholes, Wells, Pumping, Water supply, Water storage, Drainage water, Porosity, Permeability, Infiltration, Carbon dioxide, Methane, Coals.
Identifiers: *Romania, Baraolt basin.

To evaluate the hydrogeological conditions of the coal deposits of the Baraolt basin, the water-bearing strata of the basin were investigated down to a depth of 150 feet. Analysis of the experimental pumping well data shows that the amount of water discharge is a function of the horizon permeability and grain size. Carbon dioxide and weak emanations of methane gas are present in the aquifers, with the carbon dioxide content somewhat increasing with depth. Hydrological conditions of the coal deposits are of a very difficult and complicated nature. (Gabriel-USGS)
W70-01909

HYDROGEOLOGIC STUDY OF MAMORA, (FRENCH),
Morocco Geological Service, Rabat.
For primary bibliographic entry see Field 02A.
W70-01911

2G. Water in Soils

RELATIONSHIPS AMONG ADSORBED PHOSPHATE, SILICA, AND HYDROXYL DURING DRYING AND REWETTING OF KAOLINITE SUSPENSION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agricultural Research; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02K.
W70-01645

REACTIONS OF Ce IN SOLUTION AND SUSPENSIONS OF SOIL HUMIC ACID AND BENTONITE,
Ohio Agricultural Research and Development Center, Wooster; and Ohio State Univ., Columbus.
For primary bibliographic entry see Field 02K.
W70-01646

ADSORPTION OF NITRATE IN AMORPHOUS AND KAOLINITIC HAWAIIAN SOILS,
Hawaii Univ., Honolulu. Dept. of Soil Science.
For primary bibliographic entry see Field 02K.
W70-01647

PROPERTIES OF SOME SOILS IN THE CUMBERLAND PLATEAU AS RELATED TO SLOPE ASPECT AND POSITION,
Soil Conservation Service, Beltsville, Md.; Soil Conservation, Knoxville, Tenn.; and Forest Service (USDA), Somerset, Ky.

D. P. Franzmeier, E. J. Pedersen, T. J. Longwell, J. G. Byrne, and C. K. Losche.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 755-761, Sept-Oct 1969. 7 p, 3 fig, 7 tab, 12 ref.

Descriptors: *Soils, *Slopes, *Soil physical properties, *Soil chemical properties, *Geomorphology, Soil temperature, Soil moisture, Soil horizons, Storage capacity.
Identifiers: Soils of Kentucky, Soils of Tennessee, Base saturation, Slope aspect, Topography-soil formation relations.

Soils developed from acid siltstones and shales were sampled on the lower, middle, and upper part of steep north and south-facing slopes in transects made across ridges in eastern Kentucky and Tennessee. Particle size distribution, base saturation, and soil temperature are related to slope position. Soils in the middle slope positions are higher in coarse material than those in the upper or lower positions. Soils in the lower slope positions have the highest base status and are coolest. Slope aspect influences soil temperature and organic matter content and the kinds of horizons formed and their color. Most soils on the south-facing slopes have argillic horizons while most on the north-facing slopes have cambic horizons. Soils on the north slope have almost 2C lower mean annual temperature, contain more organic matter, are darker in color, and hold more water during a period of water stress than soils on the south-facing slope. (Carstea-USGS)
W70-01649

INFILTRATION AND WATER DEPLETION IN LYSIMETERS,
Arizona Univ., Tucson. Dept. of Agricultural Chemistry and Soils.
Hasan K. Qashu.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 775-778, Sept-Oct 1969. 4 p, 3 fig, 6 ref.

Descriptors: *Lysimeters, *Water loss, *Infiltration, *Rainfall-runoff relationships, *Evapotranspiration, Forecasting, Moisture content, Water balance, Runoff, Soil water movement, Soil physical properties, Soil moisture, Vegetation effects.
Identifiers: Evapotranspiration forecasting.

Evapotranspiration losses from five lysimeters with different plant species were estimated. Prediction equations were developed and used to estimate soil water regimens, infiltration, and runoff in lysimeters with vegetative cover: Calculated soil water contents and runoff for lysimeters with 5 different plant species were good estimates of measured quantities. Water balance elements from tree-, brush-, and grass-covered soils showed variabilities between species and for total season precipitation. It is concluded that the presented procedure of estimating the elements of water balance is useful in areas with limited data. But for a physical explanation of the cause and effects in surface water/soil water continua, hydrologic relations must be sought through mathematical analysis of a time-varying system. Derived equations for estimating soil water depletion and infiltration predictors are very useful first approximations for the evaluation of 2 elements-- runoff and water storage--in the hydrologic cycle. They reveal the importance of vegetation, specifically plant species, as a principal component in the rainfall-runoff process. (Carstea-USGS)
W70-01650

EFFECTS OF PETROLEUM MULCH ON SOIL WATER CONTENT AND SOIL TEMPERATURE,
Oregon State Univ., Corvallis. Dept. of Soils.
Ahang Kowsar, L. Boersma, and G. D. Jarman.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 783-786, Sept-Oct 1969. 4 p, 6 fig, 1 tab, 14 ref. OWRR Proj B-001-ORE.

Descriptors: *Soil management, *Mulching, *Soil moisture, *Soil temperature, Evaporation control, Soil conservation, Infrared radiation, Soil physical properties, Water loss, Storage capacity, Soil water movement.
Identifiers: Petroleum mulch.

Soil temperature and soil water content were measured at 2-hour intervals in mulched and unmulched chehalis silty clay loam subjected to a diurnal temperature cycle. At the time the soil temperatures attained their maximum value at a depth of 1 cm, the mulch-covered soil was 5C warmer than the bare soil; at all other times the difference in temperature between bare and mulched soil was smaller. In the upper 1 cm of mulched soil, water was lost but the soil gained water at depths where seedlings are normally placed. It was concluded that the petroleum mulch improved soil water and soil temperature conditions. (Carstea-USGS)
W70-01651

RESOLVING TIME, MASS ABSORPTION COEFFICIENT AND WATER CONTENT WITH GAMMA-RAY ATTENUATION,
Iowa State Univ., Ames.
D. D. Fritton.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 651-655, Sept-Oct 1969. 5 p, 1 fig, 4 tab, 8 ref. AEC OWRR Proj A-003-IA.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, *Gamma rays, *Soil moisture, Analytical techniques, Soil physical properties, Instrumentation, Soil types, Soil texture, Absorption, Moisture content.
Identifiers: *Resolving time, Mass absorption coefficient, Gamma-ray attenuation, Gamma-ray scattering, Gamma-ray calibration, Gamma-ray intensity correction.

An intensity correction for gamma-ray attenuation is determined by using the minute nonlinearity of a semi-log plot of gamma-ray intensity versus the thickness or the product of thickness and density of a material. The experimentally determined correction is expressed in terms of resolving time and varied with both material and counting rate. A correction of 5.0 microseconds/count was determined experimentally as the best resolving time to correct the observed counting rates for water content determination. Part of the correction was evidently due to causes other than resolving time. Mass absorption coefficients of water and soil were 0.08105 and 0.07309 sq cm, respectively, with no correction and were 0.0871 and 0.0773 sq cm with a 5.0 microsecond/count correction. The difference between gravimetric water content and gamma-ray water content dropped from 3.02% to 0.60% when this correction was used. (Carstea-USGS)
W70-01652

EVALUATING THE USE OF Na, Ca, AND DIVALENT CATION ELECTRODES IN SOME SOIL EXTRACTING SOLUTIONS,
Hawaii Inst. of Geophysics, Honolulu.
S. A. El-Swaify, and M. N. Gazdar.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 665-667, Sept-Oct 1969. 3 p, 3 fig, 2 tab, 17 ref. Contract No 14-01-0001-673 (Office of Saline Water).

Descriptors: *Electrodes, *Chemical potential, *Ions, *Calibrations, Calcium, Magnesium, Salts, Aqueous solutions, Analytical techniques, Instrumentation, Spectrophotometry, Colorimetry, Membranes, Sodium, Soil moisture.
Identifiers: Activity, Activity coefficient.

The performances of sodium activity, calcium activity, and divalent cation activity electrodes were determined and compared with predicted theoretical responses in unbuffered systems and in buffered systems at concentrations of 0.2 m, 0.5 m, and 1.0 m. In support of previous findings on a less selective sodium electrode, results show that the Na-electrode exhibits a response which is nearly Nernstian, allowing good estimates of Na ion activities in soil extracts. In contrast, the usefulness of the calcium and divalent-electrodes in buffered systems (and subsequent usefulness for determining exchangeable ions) was found to be limited particularly at high levels of total salt concentration. Although better response was observed for these two electrodes in unbuffered systems, the determination of Ca and Mg in water-soil extracts by their combined use is limited by the apparent reversibility of the calcium electrode to Mg ions present in calcium-magnesium salt mixtures. (Carstea-USGS)
W70-01653

PROFILE MODIFICATIONS OF A SLOWLY PERMEABLE SOIL,
Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
H. V. Eck, and H. M. Taylor.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 779-783, Sept-Oct 1969. 5 p, 3 fig, 5 tab, 9 ref.

Descriptors: *Soil profiles, *Permeability, *Irrigation, *Cultivation, Soil types, Soil texture, Storage capacity, Water conservation, Soil physical properties, Soil water, Soil water movement, Productivity, Deep tillage, Texas.
Identifiers: Southwestern Great Plains Research Center, Soil profile modification, Water use efficiency.

Soil profile modification was studied in a Pullman silty clay loam at the Sothwestern Great Plains Research Center, Bushland, Texas. Three depths of profile modification (0, 90, and 150 cm) were studied under two water levels (preplant irrigation and full irrigation). Grain sorghum yields increased by 66.2 and 80.1% under limited water conditions when the profiles were modified to depths of 90 and 150 cm, respectively. Changes in amount and distribution of stored water and in rooting patterns resulted in the increased yields. Water use efficiency was increased under adequate irrigation, but there was little effect on total yields. (Carstea-USGS)
W70-01656

CONDUCTIVITY INSTRUMENTATION FOR IN SITU MEASUREMENT OF SOIL SALINITY,
Burr-Brown Research Corp., Tucson, Ariz.; and Arizona Univ., Tucson.
C. G. Enfield, and D. D. Evans.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 787-789, Sept-Oct 1969. 3 p, 8 fig, 1 tab, 5 ref.

Descriptors: *Electrical conductance, *Instrumentation, *Salinity, *Soil chemical properties, Soil physical properties, Soil temperature, Aqueous solutions.
Identifiers: Soil salinity meters.

A transducer has been developed which is capable of assessing, in situ, the electrical conductivity of soil water. The transducer is constructed of porous glass with platinum electrodes and operates over the entire field moisture range. The transducer is accurate to within 10% when measured with an associated solid state meter in a conductivity range of 1-20 millimhos/cm at 25C and a temperature range of 5-45C. Typically, the time required to achieve 63% of equilibrium response, in aqueous solutions, is less than 2 hours. (Carstea-USGS)
W70-01657

RUNOFF INDUCEMENT IN AN ARID REGION BY REMOVAL OF VEGETATION,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
For primary bibliographic entry see Field 03B.
W70-01658

THE EFFECT OF DRYING ON SOIL STRENGTH PARAMETERS,
National Tillage Machinery Lab., Auburn, Ala.
C. R. Camp, and W. R. Gill.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 641-644, Sept-Oct 1969. 4 p, 3 fig, 1 tab, 12 ref.

Descriptors: *Drying, *Soil strength, *Soil physical properties, *Soil moisture, Cohesion, Shear strength, Water loss, Soil water movement, Bulk density, Soil types, Friction.
Identifiers: *Soil moisture-strength relationships, *Unsaturated media, Triaxial shear strength.

The influence of drying on the magnitudes of the cohesion and friction angle soil strength parameters was determined for three cohesive soils. Shear strength measurements were made using a modified laboratory triaxial apparatus for three different soil types on samples prepared in the laboratory. All samples of a given soil type were molded at the same soil water content and to the same bulk density. Samples were dried slowly to soil water contents between the 1/3-bar soil water suction level and air dryness. The criterion used to determine shear was either the development of a definite failure plane or an increase in sample diameter of 0.25 mm, whichever occurred first. Volume change of the sample and the applied axial and radial stresses were measured and recorded continuously throughout a test cycle. Mohr's circles were constructed and the soil strength parameters were determined for all samples. The parameters both increased with drying for these soils. (Carstea-USGS)
W70-01662

SOIL-WATER HYSTERESIS MEASURED IN A SANDY LOAM AND COMPARED WITH THE HYSTERIC DOMAIN MODEL,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
G. C. Topp.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 645-651, Sept-Oct 1969. 7 p, 8 fig, 1 tab, 17 ref.

Descriptors: *Soil water movement, *Hysteresis, *Model studies, *Soil moisture, *Soil physical properties, Soil texture, Gamma rays, Pressure head, Hydraulic conductivity, Instrumentation, Tensiometers, Drying, Wetting, Hydraulic models.
Identifiers: *Soil-water hysteresis, Sandy loam soil, Gamma ray attenuation.

A controlled series of wetting and drying changes was applied to a uniformly packed column of sandy loam soil. The relationships between soil water content, pressure head and hydraulic conductivity were determined in the laboratory. Gamma ray attenuation provided information regarding the soil water content. A pressure transducer was used to measure simultaneous tensiometer pressures at five locations along the soil column. Different levels in the column have been used to map out scanning curves suitable for quantitative tests of the independent domain theory of hysteresis. Analysis of the primary scanning curves showed that the independent domain theory of hysteresis is an inadequate model for both wetting and drying curves. No measurable hysteresis in the water content-hydraulic conductivity relationship was observed following consolidation during the initial drying phase. (Carstea-USGS)
W70-01663

THE PREDICTION OF EVAPORATION, DRAINAGE, AND SOIL WATER STORAGE FOR A BARE SOIL,
Wisconsin Univ., Madison. Dept. of Soil Sciences.
T. A. Black, W. R. Gardner, and G. W. Thurtell.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 655-660, Sept-Oct 1969. 6 p, 8 fig, 18 ref.

Descriptors: *Evaporation, *Drainage, *Water storage, *Soil water movement, Soil moisture, Soil conservation, Storage capacity, Forecasting, Irrigation, Water management (Applied), Drying, Rainfall, Lysimeters, Capillary conductivity, Diffusivity.
Identifiers: Plainfield sand soil.

Evaporation, drainage, and changes in storage for a bare Plainfield sand were measured with a lysimeter during June, July, and August 1967, under natural rainfall conditions. Cumulative evaporation at any stage was proportional to the square root of time following each heavy rainfall. The drainage rate was found to be an exponential function of water storage. Both relations can be predicted from flow theory with knowledge of soil capillary conductivity, diffusivity, and moisture retention characteristics. Using these two relations and daily rainfall data, the water storage in the top 150 cm was predicted over the season to within 0.3 cm. (Carstea-USGS)
W70-01664

STANDARD HEATS AND ENTROPIES OF EXCHANGE FOR ALKALI METAL CATIONS ON WYOMING BENTONITE,
UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.; Louvain Univ. (Belgium). Inst. of Agronomy; and Fisk Univ., Nashville, Tenn.
For primary bibliographic entry see Field 02K.
W70-01665

THEORETICAL CONSIDERATION OF THE CALCIUM SULFATE-BICARBONATE-CARBONATE INTERRELATION IN SOIL SOLUTION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02K.
W70-01666

PROPERTIES OF VERMICULITES AND SMECTITES: EXPANSION AND COLLAPSE,
Oregon State Univ., Corvallis. Dept. of Soils.
M. E. Harward, D. D. Carstea, and A. H. Sayegh.
Clays and Minerals, Vol 16, p 437-447, 1969. 11 p, 4 fig, 7 tab, 20 ref.

Descriptors: *Analytical techniques, *Clay minerals, *Expansive clays, Moisture uptake, X-ray diffraction, Cation exchange, Beidellite, Bentonite, Montmorillonite, Mineralogy, Potassium, Calcium, Magnesium, Solvation.
Identifiers: Smectite, Vermiculite.

Samples of smectites and vermiculites were evaluated to (1) determine the effects of source and amount of charge; (2) determine if a continuum of properties exists, and (3) improve the basis for differentiating criteria for identification. The montmorillonites expanded to the equivalent two-layer complex upon solvation by condensation of ethylene glycol or glycerol vapor. Beidellite exhibited the one-layer complex with glycerol vapor and the two-layer complex with ethylene glycol. The vermiculite samples did not yield regular two-layer complexes regardless of saturating cation, prior moisture or solvating agent. A number of different complexes of vermiculite were obtained depending on conditions of solvation. Potassium-saturated vermiculites and smectites both exhibited collapsed layers in a dry atmosphere. Hydration of smectites occurred at humidities above 20% and resulted in poorly ordered diffraction maxima of 11-12 angstroms. The K-saturated vermiculites tended to retain the collapsed lattice and exhibited diffraction maxima of 10-10.6 angstroms with integral higher orders. Differences in properties can be related to both source and amount of charge. Nevertheless, a continuum in the properties of expansion and collapse between the smectites and vermiculites was not observed. The data indicate two discrete populations. (Carstea-USGS)
W70-01670

THE ESTIMATION AND OCCURRENCE OF AGRICULTURAL DROUGHT,
Department of Agriculture, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 03F.
W70-01687

SODIUM ADSORPTION RATIO INFLUENCE ON STABILIZATION POND SEALING,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering, and South Dakota State Univ., Brookings. Dept of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-01690

THE ACHIEVEMENTS OF DRAINAGE THEORY IN RELATION TO PRACTICAL NEEDS: TAKING STOCK,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
E. C. Childs.
9th International Congress of Soil Science, Adelaide, Australia, Transactions, Vol 1, 1968, p 349-356. 8 p, 23 ref.

Descriptors: *Drainage systems, *Soil physics, *Arid lands, *Irrigation, *Land reclamation, Agriculture, Soil properties, Agricultural engineering, Salinity, Hydraulic conductivity, Equations, Water table, Irrigation efficiency.
Identifiers: *U. A. R., Drainage Theory, Parameters.

Theoretical soil physics and laboratory research techniques have developed more rapidly in recent years than methods for field application. In the area of drainage problems the author proposes that emphasis be placed on development of practical methods of measurement of parameters relative to soil drainage so that the body of theory can be applied more effectively to agriculture. In arid lands where irrigation is the water source, empirical methods are probably adequate since the excess of water applied is predictable. Although a field manual for agriculturalists is not practical, a consultant well versed in theory can offer advice on large-scale problems that is superior to guess work based only on experience. An example is cited in the land reclamation project in the Lake Mariyut area on the north coast of the U. A. R. Drainage theory has made it possible to forecast here the level of a steady water table under irrigation within acceptable limits. (Crouse-Arizona)
W70-01817

EVAPORATION FROM BARE SOIL UNDER HIGH RADIATION CONDITIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02D.
W70-01818

THE INFLUENCE OF SUBSURFACE ASPHALT BARRIERS ON THE WATER PROPERTIES AND THE PRODUCTIVITY OF SAND SOILS,
Michigan State Univ., East Lansing.
A. E. Erickson, C. M. Hansen, and A. J. M. Smucker.
9th International Congress of Soil Science, Adelaide, Australia, 1968, Transactions, Vol 1, p 331-337. 7 p, 4 tab, 1 fig.

Descriptors: *Arid lands, *Sands, *Impervious membranes, *Asphalt, *Barriers, Economic feasibility, Vegetable crops, Nuclear moisture meters, Arizona, Michigan, Soil-water-plant relationships, Soil properties, Root zone, Moisture tension, Drainage, Penetration.
Identifiers: *Taiwan, Formosa.

Field trials were made with placement of an impervious asphalt barrier at various depths in sandy soils in Michigan, Arizona, and Taiwan, Formosa. The barrier increases the amount of water held in the root zone of crops. Aerial extent of the barrier is determined by drainage requirements. Soil moisture measurements were made by the nuclear probe method in arid soils. The technique has made irrigation economically feasible for high value crops. (Crouse-Arizona)
W70-01819

THEORY AND EXPERIMENT IN CANAL SEEPAGE ESTIMATION USING RADIOISOTOPES,
Bhabha Atomic Research Center, Bombay (India). Isotope Div.
K. Krishnamurthy, and S. M. Rao.
J Hydrol, Vol 9, No 3, p 277-293, Nov 1969. 17 p, 6 fig, 2 tab, 14 ref.

Descriptors: *Canal seepage, *Radioactivity techniques, *Tracers, *Tracking techniques, *Reviews, On-site investigations, Seepage, Soil water movement, Groundwater movement, Mathematical studies, Mathematical models.
Identifiers: *India, Ganga Canal.

A brief survey of the many existing computational and experimental methods in estimating seepage losses from unlined canals is given. A new method is suggested in which the filtration velocity of seepage is measured using radioisotopes. The seepage rate is then computed from the knowledge of the phreatic curve and Numerov's theoretical formula for laterally spreading seepages from unlined canals. A practical application of the procedure to estimate seepage losses from Ganga Canal near Roorkee, India is also described. (Knapp-USGS)
W70-01858

SULPHATE DISTRIBUTION IN SOLONETZIC SOIL WITH A WATER TABLE,
Alberta Univ., Edmonton. Dept. of Soil Science.
S. U. Khan, and G. R. Webster.
J Soil Sci, Vol 19, No 1, p 20-24, Mar 1968. 5 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Water chemistry, *Soil chemistry, *Soil water movement, *Sulfates, Ion transport, Aqueous solutions, Adsorption, Mineralogy, Clay minerals.
Identifiers: Solonetz, Sulfate mobility.

Soil columns were used to study sulphate distribution in Thin Duagh Loam soil as influenced by the presence of a water table. The concentration pattern showed that retention was greater in the surface soil than at lower depths. The data suggest that sulphate tends to move more slowly than water in soil. Evaporation would affect the distribution pattern but in this study its influence was negligible because it was maintained at a low level. In the lower horizons the sulphate concentration in the column decreased with decreasing acidity of the soil horizons. In this soil montmorillonite is the major clay mineral and it appears that increase in percentage of clay reduced sulphate retention in the lower horizons. The greater sulphate retention near the surface resulting from high water table in the soil under study might have some effect on the productivity of these soils. (Knapp-USGS)
W70-01866

WATER MOVEMENT IN DRY SOILS: 1. PHYSICAL FACTORS AFFECTING SORPTION OF WATER BY DRY SOIL,
Rothamsted Experimental Station, Harpenden (England).
D. A. Rose.
J Soil Sci, Vol 19, No 1, p 81-93, Mar 1968. 13 p, 9 fig, 4 tab, 9 ref.

Descriptors: *Soil water movement, *Unsaturated flow, Diffusion, Diffusivity, Sorption, Clay minerals, Expansive clays, Expansive soils, Mathematical studies, Model studies, Soil physics, Soil physical properties, Vapor pressure, Evaporation control, Hexadecanol, Temperature.
Identifiers: Atmospheric moisture uptake (Soils).

Semi-infinite columns of dry soil closed at one end had the other exposed to a turbulent atmosphere at constant relative humidity (0.98) and a range of constant temperatures. After varied times the water content of the columns were measured gravimetrically, in 1-cm layers, from which the total quantity taken up and the distribution of water content with time and distance were found. Assuming that the Boltzmann transform can be applied to the standard diffusion equation, two soil parameters are derived. The second parameter--the sorptivity, is not independent of water content or the value maintained at zero distance. Results show that in a clay soil, between pF 5.8 and pF 4.2, water moves predominantly as vapor; in a non-swelling silicate mineral (sepiolite) there is significant liquid movement between pF 5.1 and pF 4.2. Long-continued use of organic manure has little effect on either diffusivity or sorptivity; aggregate size has some effect, in opposite senses for a sand and a clay; a mulch or a still atmosphere affects sorptivity but not diffusivity; evaporation suppressants decrease sorptivity; ignition decreases sorptivity and greatly alters diffusivity; and degradation of structure causes small changes in diffusivity. (Knapp-USGS)
W70-01867

STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL,
Iowa State Univ., Ames. Dept. of Agronomy.
Sam-Arng Srinilta, D. R. Nielsen, and Don Kirkham.
Pap presented at 50th Annu Meeting of Amer Geophys Union, Wash, DC, Apr 21-25, 1968. 29 p, 17 fig, 1 tab, 12 ref.

Descriptors: *Steady flow, *Soil water movement, *Unsaturated flow, Hydraulic conductivity, Sorption, Bulk density, Soil moisture, Moisture tension, Soil profiles, Soil types, Darcy's law, Anisotropy, Pore pressure.
Identifiers: Two-layer soil, Soil columns.

A laboratory study of water moving steadily through an isothermal, two-layer soil is analyzed using Darcy's equation for unsaturated flow. Factors considered were thicknesses and kinds of topsoil and subsoil, depth of surface water ponding, magnitude of outflow water pressure, and soil-water history of the profile. Soil-water pressure distributions were measured at 5-cm depth intervals along the vertical columns. The unsaturated hydraulic conductivity was measured for sorption and desorption for each of 4 soils used as topsoil and subsoil in the two-layer columns. Values of hydraulic conductivity as a function of soil-water pressure were used to predict the measured soil-water pressure distributions and steady-state fluxes. The agreement between predicted and measured profiles is close. The necessity to distinguish between sorption and desorption, to obtain a uniform soil-bulk density distribution within each soil layer, and to ascertain the hydraulic conductivity as a function of soil-water pressure is discussed in relation to the predicted soil-water pressure distribution and flux values. (Carstea-USGS)
W70-01868

THE INFILTRATION OF ALDRIN THROUGH OTTAWA SAND COLUMNS,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05B.
W70-01904

INFLUENCE OF SAMPLE PRETREATMENT ON SOIL MOISTURE RETENTION,
Wisconsin Univ., Madison. Dept. of Soils.
D. E. Elrick, and C. B. Tanner.
Soil Science Society of America, Proceedings, Vol 19, No 3, p 279-282, 1955. 2 fig, 11 ref.

Descriptors: *Soil moisture, *Retention, Soil physics, Tensiometers, Moisture tension, Tension, Moisture content, Moisture availability, Soil texture, Wilting point, Sieve analysis, Puddling, Cores.
Identifiers: *Sample pretreatment.

Moisture retention was compared of 2-millimeter sieved, puddled, and undisturbed soil to determine whether approximate estimates of moisture retention values of undisturbed soil could be estimated by those for sieved soil. Soil samples were saturated with water and their moisture retention values determined at 11 moisture tension points with the range 0.01-15 atmospheres. Results showed that sieved soil can be used to indicate retention values of medium textured, undisturbed soil within the range of 1 to 15 atmospheres with a relative error of 10%. Below 1 atmosphere, retention values of sieved soil differed significantly from undisturbed soil ; thus, for retention values of less than 1.0 atmosphere, estimates should be made directly from undisturbed soil. It was noted that for tensions greater than 5.0 and less than 0.1 atmospheres, puddled soil provided a better estimate of retention values in undisturbed soil than did sieved soil. (Daniel-Wisconsin)
W70-01932

HYDROLOGIC PROPERTIES OF SOILS ON THREE SMALL WATERSHEDS IN THE WESTERN CASCADES OF OREGON,
Forest Service (USDA), Portland, Oreg. Pacific Northwest Forest and Range Experiment Station.
C. T. Dyrness.
USDA Forest Serv Res Note PNW-111, Sep 1969. 17 p.

Descriptors: *Soil water, *Soil surveys, *Percolation, *Storage capacity, *Soil stoniness, Soil classification, Soil porosity, Soil water movement, Wilting point, Field capacity, Moisture tension, Soil texture, Capillary water, Gravitational water, Experimental watersheds, Coniferous forests, Watershed management.

All soils mapped on three experimental watersheds were of loamy texture, and most showed minimal amounts of profile development. With one exception, rates of water movement through saturated soil cores were found to be very high. Percolation rates measured for surface horizons were unusually rapid due to the very porous and highly aggregated nature of these layers. Retention (capillary) and detention (gravitational) storage capacity values determined for the surface 4 feet of soil were extremely variable within individual soil series. The single most important factor causing variation was stone content of the soils. Each of the four most widespread soil series was divided into two new soil units on the basis of stone content. The resultant soil units had substantially reduced variation in water storage capacity values. Average retention storage capacity values for the surface 4 feet of soil ranged from approximately 6 to 14 inches, and average detention capacities varied from about 8 to 14 inches. Maximum storage capacity available at the end of the summer dry season is estimated to range from about 30 to 40 percent of the total retention capacity values for these soils.
W70-02040

2H. Lakes

DIVERSION BY LAKE PIERCING, SNETTISHAM PROJECT,
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 08B.
W70-01661

MICROPARTICULATES: ISOLATION FROM WATER AND IDENTIFICATION OF ASSOCIATED CHLORINATED PESTICIDES,
Ohio State Univ., Columbus. Dept. of Microbial and Cellular Biology.
For primary bibliographic entry see Field 05A.
W70-01669

INCREMENTAL STRESS UNDER A TWO-DIMENSIONAL ARTIFICIAL LAKE,
Alberta Univ., Edmonton. Dept. of Physics.
For primary bibliographic entry see Field 08E.
W70-01679

FLOW-THROUGH SAMPLING SYSTEM FOR SMALL BOATS OR ICE SHELTER,
Geological Survey, Washington, D.C.; and Geological Survey, Fort Wayne, Ind.
For primary bibliographic entry see Field 07B.
W70-01900

MAJOR TEMPERATURE CHARACTERISTICS OF WATER IN THE WEST-CENTRAL PART OF THE CASPIAN SEA (IN AZERBAIDZHAN),
For primary bibliographic entry see Field 02B.
W70-01910

AN INVESTIGATION BY RAPID CARBON-14 BIOASSAY OF FACTORS AFFECTING THE CULTURAL EUTROPHICATION OF LAKE TAHOE, CALIFORNIA-NEVADA,
California Univ., Davis. Dept of Zoology; and Engineering-Science Inc., Oakland, Calif.
For primary bibliographic entry see Field 05C.
W70-01933

SEASONAL CHANGES IN THE ATTACHED ALGAE OF FRESHWATER AND SALINE LAKES IN THE LOWER GRAND COULEE, WASHINGTON,
Oregon Univ., Eugene. Dept. of Biology.
Richard W. Castenholz.
Limnology and Oceanography, Vol V, No 1, p 1-28, Jan 1960. 10 fig, 6 tab, 38 ref.

Descriptors: *Algae, *Lakes, *Fresh water, *Saline lakes, *Washington, Alkaline water, Diatoms, Productivity, Conductivity, Hydrogen ion concentration, Dissolved solids, Sampling, Temperature, Ice, Ions, Chlorophyta, Cyanophyta, Primary productivity, Limnology.
Identifiers: *Seasonal effects, *Lower Grand Coulee (Wash), *Epilithic algae, *Epiphytic algae, Cymbella, Diatoma elongatum, Fragilaria vaucheriae, Gomphonema eriense, Nitzchia, Synedra, Epithemia, Rhopalodia gibba, Cladophora, Spirogyra, Oscillatoria, Chlorococcales, Ulothrix, Amphora, Production rate, Species composition, Glass plates, Species diversity, Depth effects, Comparative studies.

Investigations during a two year period of two freshwater alkaline lakes and two saline lakes in Lower Grand Coulee, Washington, have provided quantitative and qualitative records of seasonal changes in non-planktonic algae. Relative dominance was evaluated, based on the mathematical product of the cell count and a calculated volume factor for each species. In freshwater lakes, bimodal production curves, with the peak generally higher in spring than in fall, were evident. Lowest production occurred in late summer. Comparison of two years' results shows differences in total production at comparable times, but seasonal distribution of species was similar. In fresh water, diatom species, dominant in spring, were replaced by others in summer, which was also characterized by an abundance of Cladophora, Spirogyra, Oscillatoria, and members of the Chlorococcales. Dominant summer diatoms usually remained through autumn, and were then joined by several vernal species. In winter, diatom production was low, but Ulothrix clothed rocks in Falls Lake even under ice. Of 275 algal taxa from Lower Grand Coulee, 9% occurred in both fresh water and saline. (Jones-Wisconsin)
W70-01938

USE OF MODIFIED DIURNAL CURVES FOR THE MEASUREMENT OF METABOLISM IN STANDING WATER,
Toronto Univ. (Ontario). Dept. of Zoology.
Harold E. Welch.
Limnology and Oceanography, Vol 13, No 4, p 679-687, 1968. 6 fig, 1 tab, 31 ref.

Descriptors: *Biological communities, *Metabolism, *Methodology, *Photosynthetic oxygen, Oxygen, Photosynthesis, Ponds, Primary production, Georgia, Eutrophication, Carbon dioxide, Hydrogen ion concentration, Sampling.
Identifiers: *Community metabolism, *Diurnal oxygen curves, Winkler technique, Lago Pond (Ga).

A method is described for adapting, to limnetic situations, the estimation of community metabolism from diurnal variations in oxygen concentration of free water. Water samples were taken by vacuum, using polyethylene tubing fitted with baffles to aid in sampling thin layers. Samples, at intervals of 25 centimeters from surface to anaerobic layer (depth, 2.5 meters), were taken each hour to establish diurnal curve of oxygen concentrations, as determined by azide modification of Winkler technique. During course of a year, samples yielded values of corrected gross photosynthesis (in grams oxygen/square meter per day) varying between 2.2 (January) to 10.0 (June-August). This technique avoids disadvantages of bottle methods which are related to sharp chemical stratification of the water column, diurnal migration of algae, and production of gas bubbles. Procedure also minimizes ecosystem disturbance and lessens possible diffusion errors. Chief disadvantage is its dependance on significant volumetric changes in oxygen or carbon dioxide. Figures in the report include a schematic diagram of the sampling system, and representative oxygen and pH profiles of Lago Pond, a small, fertile Georgia farm impoundment. (Voigtlander-Wisconsin)
W70-01941

PROCEEDINGS OF THE CONFERENCE ON CHANGES IN THE BIOTA OF LAKES ERIE AND ONTARIO.
Buffalo Society of Natural Sciences, N.Y.; and State Univ. of New York, Buffalo. Research Foundation.
For primary bibliographic entry see Field 05C.
W70-01942

CHANGES IN THE BIOLOGY OF THE LOWER GREAT LAKES,
Ohio State Univ., Columbus. Natural Resources Inst.
For primary bibliographic entry see Field 05C.
W70-01943

PLANTS IN LAKES ERIE AND ONTARIO, AND CHANGES OF THEIR NUMBERS AND KINDS,
Memorial Univ. of Newfoundland, St. Johns. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W70-01944

CHANGES IN THE BENTHOS OF LAKES ERIE AND ONTARIO,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-01945

2I. Water in Plants

ATRIPLEX POLYCARPA: I. GERMINATION AND GROWTH AS AFFECTED BY SODIUM CHLORIDE IN WATER CULTURES,
California Univ., Riverside. Dept. of Agronomy.
N. Jerry Chatterton, and Cyrus M. McKell.
Agronomy Journal, Vol 61, No 3, May-June 1969, p 448-450. 1 tab, 2 fig, 11 ref.

Descriptors: *Salt tolerance, *Plant growth, *Germination, *Desert plants, *Saline soils, Grazing, Soil-water-plant relationships, Halophytes, Seeds, Osmosis, Forages, Sodium chloride, Root development, Growth stages.
Identifiers: *Desert saltbush.

Many of the arid regions of the world have a salinity problem. In this laboratory study the authors report effects of varying levels of sodium chloride on germination and growth of desert saltbush (Atriplex polycarpa)-- an evergreen shrub which offers potential as a forage plant in arid areas. Germination was severely reduced when seedlings were placed in solutions having osmotic potentials of -4.20 atmospheres. At -16.82 atmospheres there was essentially no germination. Growth of established seedlings under greenhouse conditions was reduced but not halted by salt concentrations as great as -24.00 atmospheres osmotic potential (39,000 ppm in solution). Greatest tolerance was shown by plants from a Bishop, California, population. Desert saltbush was found very tolerant to NaCl and was suggested as a good forage plant for supporting grazing in arid areas with high salinity. (Crouse-Arizona)
W70-01800

GRASS SEEDING IN THAL, WEST PAKISTAN,
Norman H. French.
Annals of Arid Zone, Vol 7, No 2, p 221-229, 1968. 2 tab.

Descriptors: *Vegetation regrowth, *Arid lands, *Range management, *Revegetation, *Weed control, *Costs, Range grasses, Economic feasibility, Cost-benefit ratio, Grazing, Forages, Seeds, Livestock, Sands.
Identifiers: *West Pakistan, Reseeding.

Average annual rainfall in the Thal area of West Pakistan ranges between five and eight inches. Such land is too arid to support cultivation, yet investigations showed that it had supported adequate grass for livestock production in the past. Serious overgrazing for possibly a century had changed the ecological complex and all but eliminated desirable species of grass. The problem was to find suitable species that could utilize available soil moisture to support livestock grazing. Research by the Central Arid Zone Research Institute, Jodhpur, India, had indicated certain suitable species. Trials in Thal developed proper methods for seeding and increasing forage from 200 to more than 1500 pounds per acre. Such an increase is apparently possible for millions of acres of similar area. Estimated costs and returns are given together with a guide for proper stocking to maintain forage production. Economic feasibility, however, depends on use of high quality, productive stock. (Crouse-Arizona)
W70-01808

WATER USE AND MANAGEMENT OF PONDEROSA PINE IN NORTHERN ARIZONA,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 03B.
W70-01829

MOISTURE CONDENSATION ON WINTER VEGETATION,
Arizona Univ., Tucson. Dept. of Agricultural Engineering.
K. R. Frost.
Progressive Agriculture in Arizona, Vol 19, No 2, p 20-22, Mar-Apr 1967. 3 p, 5 fig.

Descriptors: *Condensation, *Grasses, *Arizona, *Water yield improvement, *Dewpoint, Dew, Arid lands, Evapotranspiration, Lysimeters, Vegetation effects, Temperature, Moisture availability, Air temperature, Frost.

A study over a period of four winters in arid areas near Tucson, Arizona, showed that nighttime condensation on grasses and grain crops could make a meaningful contribution to the water supply of these crops. Measurements were made with an evapotranspirometer (weighing lysimeter). Part of the condensed moisture entered the soil and was available to the plant roots while part remained on the leaves where it helped reduce evapotranspiration losses during the following day. Analysis of the data showed that nighttime condensation depended on 1.) number of hours the ground level temperature was below dewpoint, (2) ground level air movement, and (3) surface area of the vegetation.

Maximum yield occurred when (1) surface temperature was below dewpoint all night, (2) grass was upright and variable in height, and (3) air movement was relatively low. (Crouse-Arizona)
W70-01835

PLANTS IN LAKES ERIE AND ONTARIO, AND CHANGES OF THEIR NUMBERS AND KINDS,
Memorial Univ. of Newfoundland, St. Johns. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W70-01944

2J. Erosion and Sedimentation

PROPERTIES OF SOME SOILS IN THE CUMBERLAND PLATEAU AS RELATED TO SLOPE ASPECT AND POSITION,
Soil Conservation Service, Beltsville, Md.; Soil Conservation, Knoxville, Tenn.; and Forest Service (USDA), Somerset, Ky.
For primary bibliographic entry see Field 02G.
W70-01649

MAWSON 'TILLITE' IN ANTARCTICA: PRELIMINARY REPORT OF A VOLCANIC DEPOSIT OF JURASSIC AGE,
Maine Univ., Orono. Dept. of Geological Science.
H. W. Borns, Jr., and B. A. Hall.
Science, Vol 166, No 3907, p 870-872, Nov 1969. 3 p, 2 fig, 7 ref. NSF Grant No GA-1148.

Descriptors: *Sedimentary petrology, Glacial drift, *Mudflows, Sedimentary rocks, Antarctic, Sedimentary structures.
Identifiers: Tillite, Volcanic rocks, Pyroclastics.

Reexamination of the Mawson 'Tillite' (Jurassic) of Antarctica indicates that the deposit is of volcanic origin and consists largely of both primary and reworked volcanic materials. No evidence diagnostic of a glacial origin was found. (Knapp-USGS)
W70-01667

GRAYWACKE MATRIX MINERALS: HYDROTHERMAL REACTIONS WITH COLUMBIA RIVER SEDIMENTS,
Scripps Institution of Oceanography, La Jolla, Calif. Geol Res Div, and Washington Univ., Seattle. Dept. of Oceanography.
James W. Hawkins, Jr., and John T. Whetten.
Science, Vol 166, No 3907, p 868-870, Nov 1969. 3 p, 2 tab, 12 ref. NSF Grants GP-3591, GA-15706, and GA-634. AEC contract AT (45-1)-1725.

Descriptors: *Diagenesis, *Water chemistry, *Sediments, Mineralogy, Chemical reactions, Laboratory tests, Geochemistry.
Identifiers: Graywackes, Hydrothermal alteration, Columbia River sediments.

Experiments with sands chemically similar to graywackes produced 'matrix' minerals at 250 deg C and a water pressure of 1 kilobar. Starting materials were moderately well sorted sands containing abundant volcanic rock fragments and no detectable clay minerals. The results support the concept that graywacke matrix may form diagenetically by hydration and recrystallization of unstable clasts. Matrix need not be a recrystallized detrial fine fraction. Texture, therefore, is not a reliable criterion for sandstone classification. For graywackes, chemical composition may be more significant. (Knapp-USGS)
W70-01668

CARBONATE SEDIMENTS: ORIENTED LITHIFIELD SAMPLES FROM THE NORTH ATLANTIC,
Bedford Inst., Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.; and Queen's Univ., Kingston (Ontario). Dept. of Geological Sciences.
Grant A. Bartlett, and Robert G. Greggs.
Science, Vol 166, No 3906, p 740-741, Nov 1969. 2 p, 1 fig, 4 ref.

Descriptors: *Carbonate rocks, *Sedimentation, *Lithification, *Atlantic Ocean, Marine geology, Sediment distribution, Stratification, Drill holes, Organic matter, Dating.
Identifiers: *Sediment orientation, *North Atlantic ocean, Nonlithified carbonates, Seamounts.

Differences between oriented indurated carbonate samples, obtained from the North Atlantic sea floor with deep-sea coring apparatus, are described. Two main types of lithology occur in the samples; one is mostly nonlithified layers of corals, gastropods, pelecypods, and foraminifera; the other is a lithified carbonate of hard layers, mostly globigerina-pteropod oozes with a few molluscan fragments, but sometimes lacking in organic constituents. Lithified and nonlithified couplets of sediments can be related in age and orientation as a result of the findings of the described study. Age determinations with carbon-14 show that adjacent layers of lithified and nonlithified carbonate sediments may differ in age by more than 30,000 years. (Lang-USGS)
W70-01678

SEDIMENTS OF THE ANDAMAN BASIN, NORTHEASTERN INDIAN OCEAN,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
Kelvin S. Rodolfo.
Marine Geol, Vol 7, No 5, p 371-402, Oct 1969. 32 p, 15 fig, 1 tab, 43 ref. Grant Nos. GP-2530, GA-730, and GA-1072 NSF.

Descriptors: *Sedimentation, *Sedimentary basins (Geological), *Provenance, *Deposition (Sediments), *Sedimentation rates, Currents (Water), Climates, Sediment distribution, Sediment yield.
Identifiers: Bay of Bengal, Irrawaddy River.

The Andaman Basin is an area of 800,000 sq km separated from the Bay of Bengal by the Andaman-Nicobar Ridge. The basin's principal sediment source is the Irrawaddy River's annual load of about 265 million metric tons of silty clay. Climate and physiography trap most of this sediment in the basin; over 90% of Burmese rainfall, 80% of runoff and 87% of sediment discharge result from the southwest monsoon. Prevailing winds of this season drive westerly currents which displace the turbid Irrawaddy discharge eastward from the river's mouth. The eastern and inner Irrawaddy delta-shelf is accumulating 90% of this sediment at a rate of 200 cm/100 year. Contribution from the Irrawaddy constitutes 86% of the central trough's sediment, the difference being foraminiferal carbonate. Areal patterns of sediment parameters indicate that basinward transport of Irrawaddy sediment is controlled by bottom topography. Depositional rates average 15 cm/1,000 year in the central trough, which has a total fill of about 1.5 km. The beveled Malay continental margin and the absence of any other logical provenance for thick flysch-like Tertiary sediments in the Andaman-Nicobar Ridge suggest that the basin began to form in the Late Miocene as Malaya rifted away from the Andaman-Nicobar Ridge. (Knapp-USGS)
W70-01691

GEOMORPHIC EFFECTS OF THE MAY 1967 FLOOD IN GRABURN WATERSHED, CYPRESS HILLS, ALBERTA, CANADA,
Queen's Univ., Kingston (Ontario); and Bishop's Univ., Lennoxville (Quebec).
J. J. McPherson, and W. F. Rannie.
J Hydrol, Vol 9, No 3, p 307-321, Nov 1969. 15 p, 9 fig, 2 tab, 18 ref.

Descriptors: *Floods, *Erosion, *Sediment yield, Flood plains, Sedimentation, Gravels, Sands, Silts, Clays, Geomorphology, Provenance, Hydrology, Climates, Bed load, Discharge (Water), Stream erosion.
Identifiers: *Canada, Alberta, Graburn watershed.

In May 1967, a flood which was at least a 50 year flood occurred in Graburn watershed in the Alberta Cypress Hills. During the 6 day flood period from May 16th to May 21st, 1,023 tons of sediment were removed in solution, 17,400 tons in suspension and 28,300 tons as bed load. An average thickness of 0.09 feet of fresh overbank material was deposited by the floodwaters. Gravel, as well as the more normal vertical accretion silt and clay material was laid down on the floodplain surface. Comparison of the rate of denudation calculated for the flood (0.0013 feet) with other reported rates, suggest that it is not as high as might be expected for a flood of this magnitude. (Knapp-USGS)
W70-01856

PRELIMINARY EXPERIMENTS ON HYDRODYNAMIC MOVEMENT INDUCED BY EVAPORATION AND THEIR BEARING ON THE DOLOMITE PROBLEM,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. Jinghwa Hsu, and Christoph Siegenthaler.
Sedimentology, Vol 12, No 1-2, p 11-25, Apr 1969. 15 p, 2 fig, 1 tab, 29 ref.

Descriptors: *Water chemistry, *Groundwater movement, *Diagenesis, *Dolomite, *Evaporation, Hydraulic gradient, Carbonates, Chemical precipitation, Sands, Silts, Permeability, Porosity, Water levels, Mineralogy, Flow rates, Hydraulic models, Model studies, Hydrodynamics.
Identifiers: *Dolomitization, Evaporative pumping.

Experiments were performed to demonstrate that saline interstitial waters under an arid coastal plain could be set in hydrodynamic movement to replace the evaporative loss near the surface. In contrast to movement in a vadose zone, which is related to capillary forces caused by surface tension, this movement is induced by a vertical hydraulic gradient under the evaporated area. Experiments further verified that flow rate induced by evaporative pumping was directly governed by evaporation alone; linear flow rate through coarse sand and that through very fine silt was approximately the same under the same evaporative condition. Yet the movement apparently obeyed Darcy's law. The gradient was much greater in relative impermeable silt than in permeable sand, as is required if the water to replace evaporative loss is to flow with the same rate through those media. Hydrodynamic movement induced by evaporation could be an effective mechanism to transport magnesium-bearing solutions through relatively impermeable sediments of an arid coastal plain. Dolomitization by evaporative pumping could proceed at a rate to account for the origin of Recent dolomite crusts, and for the great thickness of ancient supratidal dolomites. Dolomitization by seepage reflux or by groundwaters cannot be extensive, because of the inadequate magnesium-supply of such waters. (Knapp-USGS)
W70-01860

EARLY DIAGENETIC CEMENTATION OF RECENT SANDS, FRASER RIVER DELTA, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Geology; and British Columbia Univ., Vancouver. Inst. of Oceanography.
R. E. Garrison, J. L. Luternauer, E. V. Grill, R. D. MacDonald, and J. W. Murray.
Sedimentology, Vol 12, No 1-2, p 27-46, Apr 1969. 20 p, 10 fig, 1 tab, 44 ref.

Descriptors: *Diagenesis, *Sediments, *Calcite, *Sands, *River beds, Groundwater movement, Sedimentation, Water chemistry, Deltas, Saline water intrusion, Sea water, Mineralogy, Calcium carbonate, Chemical precipitation.
Identifiers: British Columbia, Fraser River.

Modern terrigenous sediments cemented by low-magnesian calcite are found in distributary channels and adjacent shallow-water marine localities at the front of the Fraser River delta. These per-

manently submerged areas are usually covered by sea water, including sea water intruded upstream along bottoms of river channels. The cemented sediments occur as irregular to platy nodular masses at or near to sediment-water interface, where they are frequently encountered during dredging. The cement consists of small crystals arranged in fibrous rims and other aggregates around and between sand grains. Processes leading to cementation are not yet known, but may include dissolution of calcareous shells by pore waters in buried sediments, followed by precipitation of calcite at higher levels from these fluids as they are expelled upward during compaction. (Knapp-USGS)
W70-01861

RECENT LITTORAL AND SUBLITTORAL HIGH-Mg CALCITE LITHIFICATION IN THE MEDITERRANEAN,
Uppsala Univ. (Sweden). Dept. of Historical Geology and Paleontology.
Torbjorn Alexandersson.
Sedimentology, Vol 12, No 1-2, p 47-61, Apr 1969. 15 p, 6 fig, 2 plate, 31 ref.

Descriptors: *Diagenesis, *Mineralogy, *Water chemistry, *Lithification, Carbonates, Magnesium, Calcite, Dolomite, Coral, Algae, Reefs, Sediments, Bottom sediments.
Identifiers: Aragonite, Mediterranean.

Lithification caused by inorganic precipitation of high-Mg calcite is reported from several localities in the Mediterranean. A micritic calcite cement with 13-15 mol. % Mg carbonate in solid solution lithifies internal sediments and forms open-space fillings within a sublittoral algal framework in which the biogenic structures are gradually obliterated through the activity of numerous boring organisms and the subsequent precipitation of micrite. The silt-mud fraction of unconsolidated bottom sediments is to a large extent stable low-Mg calcite, and is not the source of the micrite; instead the cementing mineral is assumed to precipitate directly from interstitial sea water aided by organic activity. The same phase of high-Mg calcite also forms the cement in beachrock; the Mg-content is an original property and not the result of diagenetic changes. The cement occurs partly as micrite, identical to the micrite in the lithified algal framework, and partly as radiating microspar fringes. In the present marine environment high-Mg calcite may substitute for aragonite as the mineral form of precipitated calcium carbonate. (Knapp-USGS)
W70-01862

THE CHEMISTRY OF SUBMARINE CEMENT FORMATION AT DOHAT HUSSAIN IN THE PERSIAN GULF,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (The Netherlands).
K. De Groot.
Sedimentology, Vol 12, No 1-2, p 63-68, Apr 1969. 6 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Diagenesis, *Lithification, *Bottom sediments, *Water chemistry, Mud, Carbonates, Calcite, Dolomite, Aqueous solutions, Solubility, Chemical precipitation, Magnesium.
Identifiers: Aragonite, Pore water.

A chemical study made at Dohat Hussain lagoon in Qatar, has supported other field observations that submarine carbonate cementation is probably active today. The source of the cement is the lagoon water, supersaturated with aragonite. In the lagoon the supersaturation is too low to effect spontaneous nucleation and thus precipitation of carbonate, but just below the sediment-water interface both the presence of a stable substrate and supersaturation promote aragonite precipitation. In soft sediment layers in between cemented layers no supersaturation was found. (Knapp-USGS)
W70-01863

OPTIMIZING SEDIMENT SAMPLING PLANS,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-01870

HOLOCENE INTERTIDAL CALCIUM CARBONATE CEMENTATION, QATAR, PERSIAN GULF,
Illing (V. C.) and Partners, Cheam (England).
For primary bibliographic entry see Field 02L.
W70-01872

SUBMARINE LITHIFICATION OF HOLOCENE CARBONATE SEDIMENTS IN THE PERSIAN GULF,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (The Netherlands).
For primary bibliographic entry see Field 02L.
W70-01873

GRAVELS OF THE SOUTHERN NORTH SEA,
Geological Inst., Groningen (Netherlands).
For primary bibliographic entry see Field 02L.
W70-01874

THE ORIGIN OF HOLOCENE SHELL DEPOSITS IN THE CHENIER PLAIN FACIES OF ESSEX (GREAT BRITAIN),
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 02L.
W70-01875

STRATIGRAPHY AND GEOLOGIC HISTORY OF THE SABKHA, ABU DHABI, PERSIAN GULF,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology; and Mobil Research and Development Corp., Dallas, Tex.
G. Evans, V. Schmidt, P. Bush, and H. Nelson.
Sedimentology, Vol 12, No 1-2, p 145-159, Apr 1969. 15 p, 5 fig, 1 plate, 3 tab, 18 ref.

Descriptors: *Chemical precipitation, *Evaporation, *Arid lands, *Mineralogy, Sediments, Gymsum, Anhydrite, Dolomite, Magnesium, Halides, Salts, Groundwater, Water chemistry, Water temperature, Water levels, Brines, Sea water, Salinity, Sands, Carbonate rocks.
Identifiers: *Persian Gulf, Sabkha, Abu Dhabi, Pore water.

The sabkha, an arid coastal plain of Abu Dhabi on the coast of the Persian Gulf, was formed during the past 7,000 years by wind erosion of pre-existing dunes and progradation of subaqueous, intertidal, and supratidal carbonate sediments. Marine transgression began in this area about 7,000 years ago and reached an apparent high about 1 m above its present level somewhat prior to 4,000 years B. P. Since then progradation of intertidal and supratidal sediments has taken place; this began 3,750 years ago. Arid conditions and evaporation on the sabkha have produced large amounts of gypsum and anhydrite and lesser amounts of dolomite, magnesite, celestite and halite. (Knapp-USGS)
W70-01892

RELATIONS OF JOINTING TO ORIENTATION OF SOLUTION CAVITIES IN LIMESTONES OF CENTRAL PENNSYLVANIA,
Geological Survey, Washington, D.C.
Ruth G. Deike.
Amer J Sci, Vol 267, No 10, p 1230-1248, Dec 1969. 19 p, 10 fig, 2 tab, 9 ref.

Descriptors: *Karst, *Pennsylvania, *Geologic control, Caves, Limestones, Solubility, Joints (Geology), Fractures (Geology), Groundwater movement, Geology, Permeability, Anisotropy, Hydrogeology, Structural geology, Folds (Geology), Geomorphology.
Identifiers: Cave orientation-jointing relations.

Twenty-six caves located in anticlinal, limestone-floored valleys of Central Pennsylvania were studied by division into passage segments inferred to have formed along the strike of fracture planes. Statistically preferred orientations of these segments were calculated. For each cave passage, an average passage orientation was calculated. Fractures measured at outcrops near the caves were classed by their preferred orientations. The average passage orientation compared with the orientation of fracture frequency was significant to the 95% level, and a plot of the relationship proved to be broadly linear. The most abundant fractures are vertical strike joints and steeply dipping bedding planes, and they lie parallel both to the anticlinal axes and down-valley water flow, suggesting increased solution along vertical joints. Individual cave patterns were found to reflect local fracture systems where: (1) linear caves develop along more steeply dipping and probably more closely spaced bedding planes; (2) several caves, particularly along flanks of folds, develop major passages along a set of the same subparallel fractures; (3) as the local structure changes the fracture orientation, the cave passages parallel the local fractures; (4) widely-spaced cave passages develop where intersecting fracture sets are also widely spaced. (Knapp-USGS)
W70-01893

COMPARATIVE RESULTS OF SEDIMENT SAMPLING WITH A SURFACE SAMPLER AND DEPTH-INTEGRATING SAMPLERS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 07B.
W70-01897

AN ANALYSIS OF SOME DATA FROM NATURAL ALLUVIAL CHANNELS,
Geological Survey, Tucson, Ariz.
George H. Caddie.
In: Geol Surv Res 1969, Prof Pap 650-C, p C188-C194, 1969. 7 p, 7 fig, 6 ref.

Descriptors: *Sediment transport, *Alluvial channels, *Friction, Sediment discharge, Sediment load, Colorado River, Statistical methods, Data collections, Sampling, Data processing, Discharge (Water).
Identifiers: Glen Canyon Dam.

Recent work on the geometry of stream channels has resulted in a hypothesis that the friction factor of any stream flowing in alluvium is virtually indeterminate because friction is the result of specific constraints placed upon the stream. The relationships between velocity, unit discharge, and slope for several locations on the Colorado River below Glen Canyon Dam are different from those of channels in which depth, velocity, and discharge all vary with changes in load and discharge. Apparently this is so because the stream is degrading its bed at these locations. Some natural streams, unaffected by manmade reservoirs, are shown to have the same characteristics. (Knapp-USGS)
W70-01898

A MUDFLOW IN THE SECOND CREEK DRAINAGE, LAKE TAHOE BASIN, NEVADA, AND ITS RELATION TO SEDIMENTATION AND URBANIZATION,
Geological Survey, Carson City, Nev.
Patrick A. Glancy.
In: Geol Surv Res 1969, Prof Pap 650-C, p C195-C200, 1969. 6 p, 7 fig, 1 tab, 2 ref.

Descriptors: *Mudflows, *Urbanization, *Sedimentation, *Nevada, Erosion, Soil erosion, Mass wasting, Channel morphology, Channel erosion, Floods, Deposition (Sediments).
Identifiers: Lake Tahoe Basin (Nev).

A mudflow of more than 50,000 cubic yards occurred in the 1.5-square-mile Second Creek basin on August 25, 1967, after an intense thundershower. Although the mudflow originated natu-

rally, its path was affected by manmade features. It damaged real estate and roadways in the lower part of the drainage, and also polluted Lake Tahoe. The mudflow probably is typical of one erosional process believed common throughout the area. The sequence includes sheet and rill erosion of non-forested uplands, severe downstream channel erosion that flushes out alluvium previously accumulated as a result of normal runoff and mass wasting, and extensive deposition along the flatter and lower part of the drainage. Estimates suggest that sheet and rill erosion of the upper basin contributed 60 to 80% of the debris, with the rest derived from the main channel. The event caused landscape denudation that averaged about 0.02 ft over the entire basin. Results of this reconnaissance influenced design of drainage structures for a new highway route through the area. (Knapp-USGS)
W70-01899

SIMPLIFIED PUMPING SAMPLER FOR SUSPENDED SEDIMENT,
Geological Survey, Sacramento, Calif.
For primary bibliographic entry see Field 07B.
W70-01902

AMINO ACID LEVELS IN THE ARGENTINE BASIN SEDIMENTS: CORRELATION WITH QUATERNARY CLIMATIC CHANGES,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 02L.
W70-01934

2K. Chemical Processes

RELATIONSHIPS AMONG ADSORBED PHOSPHATE, SILICA, AND HYDROXYL DURING DRYING AND REWETTING OF KAOLINITE SUSPENSION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agricultural Research; and Colorado State Univ., Fort Collins.
B. Bar-Yosef, U. Kafkafi, and N. Lahav.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 672-677, Sept-Oct 1969. 6 p, 7 fig, 14 ref. Proj No A-2 (Ford Foundation).

Descriptors: *Adsorption, *Chemical reactions, *Phosphates, *Silica, *Drying, Wetting, Clay minerals, Aqueous solutions, Kaolinite, Acidity, Suspension.
Identifiers: Langmuir equation, Peerless kaolinite.

The effects of drying-wetting cycle of a kaolinite suspension on the relationships between phosphate, silica, and hydroxyl in solution were studied. As predicted by the Langmuir adsorption equation, the concentration of P in the equilibrium solution remained constant during the drying process; in contrast, the concentration of silica increased. A competition between phosphate and silica on adsorption sites was observed between pH 7 and pH 9. The amount of hydroxyls needed to desorb a given amount of phosphate was increased by oven drying the kaolinite in the presence of phosphate. (Carstea-USGS)
W70-01645

REACTIONS OF Ce IN SOLUTION AND SUSPENSIONS OF SOIL HUMIC ACID AND BENTONITE,
Ohio Agricultural Research and Development Center, Wooster; and Ohio State Univ., Columbus.
R. E. Brown, R. E. Franklin, and R. H. Miller.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 677-681, Sept-Oct 1969. 5 p, 6 fig, 1 tab, 13 ref. Grant RH00124 PHS.

Descriptors: *Cesium, *Radioisotopes, *Cation exchange, *Chelation, *Humic acids, Clay minerals, Suspension, Aqueous solutions, Acidity, Bentonite, Hydrogen, Calcium, Potassium, Humic acids, Cation adsorption.
Identifiers: *Ionic strength, *Fission products, Radiocolloids.

The effects of pH, ionic strength of solutions and exchangeable cation on complex formation between Ce and soil colloids were studied in suspensions of humic acid, bentonite clay, and a mixture of these two colloids saturated with Ca or K and H. The equilibrium is shifted towards the radiocolloidal form of Ce as ionic strength and Ce concentration decrease and as pH increases. In the Ca-H saturated system, humic acid adsorbed much greater amounts of Ce than did dentonite. In the K-H saturated systems, similar amounts of Ce were adsorbed by both bentonite and humic acid. A more favorable orientation of the humic acid molecule for chelation of Ce explains the strong bonding of Ce by Ca-humic acid and humic acid-bentonite mixtures. (Carstea-USGS)
W70-01646

ADSORPTION OF NITRATE IN AMORPHOUS AND KAOLINITIC HAWAIIAN SOILS,
Hawaii Univ., Honolulu. Dept. of Soil Science.
B. R. Singh, and Y. Kanehiro.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 681-683, Sept-Oct 1969. 3 p, 1 fig, 2 tab, 16 ref.

Descriptors: *Anion adsorption, *Nitrates, *Anion exchange, *Soil chemistry, Kaolinite, Clay minerals, Soils, Soil types, Sulfates, Chlorides, Water chemistry.
Identifiers: *Hawaiian soils, Akaka silty clay, Wahiawa silty clay, Amorphous soil materials.

The adsorption of nitrate in an amorphous Akaka silty clay and kaolinite Wahiawa silty clay increased consistently with increasing concentration and decreasing pH of the electrolyte solution. The magnitude of adsorption was higher in the Akaka than in the Wahiawa soil. The amount of adsorbed nitrate was notably more when sulfate rather than Cl was used as the replacing anion. It was deduced that while the concentration-dependent nitrate adsorption is due to electrostatic and van der Waal forces, the pH-dependent adsorption is largely due to electrostatic forces. The adsorption of nitrate followed the Freundlich type of isotherm. (Carstea-USGS)
W70-01647

SOLUBILITY OF CALCIUM CARBONATE PRECIPITATED IN AQUEOUS SOLUTIONS OF MAGNESIUM AND SULFATE SALTS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
H. E. Doner, and P. F. Pratt.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 690-693, Sept-Oct 1969. 4 p, 4 tab, 17 ref.

Descriptors: *Solubility, *Calcium carbonate, *Aqueous solutions, Water chemistry, Magnesium, Sulfates, Salts, Carbon dioxide, Sodium chloride, Magnesium compounds, Calcite, Analytical techniques, X-ray diffraction, Soils, Soil water.
Identifiers: Soil water chemistry.

Calcium carbonates were precipitated in the presence of various salts at controlled carbon dioxide partial pressures. Solubilities of the precipitates were compared with that of calcite and the precipitates were compared with that of calcite and the precipitates were subjected to X-ray diffraction for the detection of crystalline products and in some cases analyzed for coprecipitated Mg. In NaCl solutions, the solubility of the carbonate was that of calcite. In magnesium chloride solutions, the solubility of the precipitate was higher than that of calcite, both calcite and aragonite were detected and Mg was coprecipitated in the solid phase. In solutions of sodium sulfate, the solubility of the precipitate was higher than in the case of the magnesium chloride solutions and both calcite and vaterite were detected. In solutions of magnesium sulfate, the solubility of the precipitate was intermediate between that of the magnesium chloride solutions and the sodium sulfate solutions. The solubility product of calcium carbonate seemed to be related mainly to the nature of the solid phase. (Carstea-USGS)
W70-01648

EVALUATING THE USE OF Na, Ca, AND DIVALENT CATION ELECTRODES IN SOME SOIL EXTRACTING SOLUTIONS,
Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 02G.
W70-01653

STANDARD HEATS AND ENTROPIES OF EXCHANGE FOR ALKALI METAL CATIONS ON WYOMING BENTONITE,
UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.; Louvain Univ. (Belgium). Inst. of Agronomy; and Fisk Univ., Nashville, Tenn.
R. G. Gast, Robert Van Bladel, and K. B. Deshpande.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 661-664, Sept-Oct 1969. 4 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Thermodynamics, *Heat, *Cation exchange, *Entropy, *Clay minerals, Bentonite, Sodium, Potassium, Selectivity, Enthalpy, Hydration.
Identifiers: *Ion hydration, *Clay-water systems, Standard heats, Standard entropy, Standard enthalpy.

Standard heats of exchange for alkali metal cation exchange on Wyoming bentonite were determined directly using a Calvet microcalorimeter and indirectly from the temperature dependence of equilibrium selectivity coefficients. Standard entropies of exchange were calculated by combining the standard heats with free energy values estimated from equilibrium selectivity coefficient determinations. While the entropy changes did contribute significantly to the standard free energies of exchange, they were only about 10% of the hydration entropy differences for Na-Li and Na-K exchange and 26 and 41% for Na-Rb and Na-Cs exchange, respectively. Both standard heat and standard free energy were always negative for uptake of the preferred cation, and absolute values increased with the degree of selectivity. (Carstea-USGS)
W70-01665

THEORETICAL CONSIDERATION OF THE CALCIUM SULFATE-BICARBONATE-CARBONATE INTERRELATION IN SOIL SOLUTION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
F. S. Nakayama.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 668-672, Sept-Oct 1969. 5 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Thermodynamics, *Water chemistry, *Bicarbonates, *Carbonates, *Sulfates, Water quality, Aqueous solutions, Soil physical properties, Soil chemical properties, Gypsum, Reclamation, Soil water, Ions, Soil moisture, Acidity, Chemical potential.
Identifiers: *Ion-pairs distributions, Activity, Activity coefficients.

The probable distributions of the ion-pairs calcium-sulfate and calcium-carbonate and complex calcium bicarbonate ion in solution are discussed thermodynamically and graphically in terms of sulfate, carbonate, bicarbonate, and hydrogen ion activities. In alkali media where the carbonate form predominates, the calcium carbonate species will dominate the calcium sulfate and calcium bicarbonate forms, and is a significant part of the total calcium in solution. The complexed and undissociated forms of Ca represent a significant portion of the total Ca in solution at equilibrium. Reclamation projects involving the improvement of soil physical and chemical properties using gypsum and other Ca sources require an understanding of these relationships. (Carstea-USGS)
W70-01666

GRAYWACKE MATRIX MINERALS: HYDROTHERMAL REACTIONS WITH COLUMBIA RIVER SEDIMENTS,
Scripps Institution of Oceanography, La Jolla, Calif. Geol Res Div, and Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02J.
W70-01668

CHEMICALS FROM SEA WATER BRINES,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-01674

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
For primary bibliographic entry see Field 03A.
W70-01676

GEOCHEMISTRY OF DEEP WATERS AND OF THE ORGANIC MATTER IN THE NORTHERN PART OF THE G. D. R. (GERMAN),
Research Inst. for the Reconnaissance and Requirements of Petroleum and Natural Gas, Gommern (East Germany).
For primary bibliographic entry see Field 02L.
W70-01680

CARBON DIOXIDE PARTIAL PRESSURE IN THE COLUMBIA RIVER,
Oregon State Univ., Corvallis. Dept. of Oceanography.
P. K. Park, L. I. Gordon, S. W. Hager, and Milton C. Cissell.
Science, Vol 166, No 3907, p 867-868, Nov 1969. 2 p, 2 fig, 7 ref. NSF Grants GP-5317, GA-1281, and GA-12113, and ONR Contract Nonr 1286-(10).

Descriptors: *Carbon dioxide, *Water chemistry, *Columbia River, Hydrogen ion concentration, Water temperature, Solutes, Aqueous solutions, Analytical techniques.
Identifiers: Dissolved carbon dioxide.

Columbia River water is supersaturated with respect to atmospheric carbon dioxide by 200 to 870 parts per million. An equilibrium exists between the carbon dioxide partial pressure and pH, and Henry's law is obeyed in this natural water. The carbon dioxide pressure can be calculated by a determination of the pH, total carbon dioxide, and temperature. (Knapp-USGS)
W70-01699

PRELIMINARY EXPERIMENTS ON HYDRODYNAMIC MOVEMENT INDUCED BY EVAPORATION AND THEIR BEARING ON THE DOLOMITE PROBLEM,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 02J.
W70-01860

THE CHEMISTRY OF SUBMARINE CEMENT FORMATION AT DOHAT HUSSAIN IN THE PERSIAN GULF,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (The Netherlands).
For primary bibliographic entry see Field 02J.
W70-01863

SULPHATE DISTRIBUTION IN SOLONETZIC SOIL WITH A WATER TABLE,
Alberta Univ., Edmonton. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-01866

MAN-MADE CARBON-14 IN DEEP PACIFIC WATERS: TRANSPORT BY BIOLOGICAL SKELETAL MATERIAL,
Scripps Institution of Oceanography, La Jolla, Calif.; and Tata Inst. of Fundamental Research, Bombay (India).
For primary bibliographic entry see Field 05A.
W70-01871

STRATIGRAPHY AND GEOLOGIC HISTORY OF THE SABKHA, ABU DHABI, PERSIAN GULF,
Imperial Coll. of Science and Technology, London (England). Dept. of Geology; and Mobil Research and Development Corp., Dallas, Tex.
For primary bibliographic entry see Field 02J.
W70-01892

GEOCHEMISTRY OF IRON IN A COASTAL-PLAIN GROUND WATER OF THE CAMDEN, NEW JERSEY, AREA,
Geological Survey, Trenton, N.J.
Donald Langmuir.
In: Geol Surv Res 1969, Prof Pap 650-C, p C224-C235, 1969. 12 p, 6 fig, 4 tab, 34 ref.

Descriptors: *Geochemistry, *Iron, *Groundwater, *Coastal plains, *New Jersey, Aquifers, Groundwater movement, Water chemistry, Water quality, Ions, Thermodynamics, Mineralogy, Oxidation-reduction potential, Hydrogen ion concentration.
Identifiers: Camden (NJ), Groundwater chemistry.

In northern Camden and northwestern Burlington Counties, N.J., the pH of groundwater in the Potomac Group and the Raritan and Magothy Formations of Cretaceous age ranges from 5-6 in the outcrop area to 8 several miles downdip to the southeast. Iron is present in the groundwater as dissolved Fe (2) ion and FeOH ion, and as suspended ferric oxyhydroxides, presumably formed by oxidation of ferrous species already in solution. The oxyhydroxides are probably a mixture of amorphous material and goethite with small amounts of hematite. In the outcrop area the concentration of dissolved ferrous or suspended ferric species is less than 0.5 milligrams per liter in unpolluted waters. Just downdip from the outcrop area, ferrous and ferric iron species increase abruptly to about 6-7 mg/1 and 6-11 mg/1, respectively. Farther downdip at pH above 6.5, both forms of iron decrease gradually to less than 0.5 mg/1. The decrease in ferrous species is not due to siderite precipitation, but may reflect an increase in the stability of suspended amorphous material owing to aging, coupled with adsorption of ferrous iron by the oxyhydroxides and partial conversion of the amorphous phase to goethite. The decrease in suspended ferric species is probably caused by cation absorption, aging, coagulation, and settling. (Knapp-USGS)
W70-01905

ORIGIN OF THE MINERALIZATION OF THE PHREATIC WATERS IN THE BUZAU-RIMNICUL SARAT INTERFLUVIAL PLAIN (ROMANIAN),
Babes-Bolyai Univ., Cluj (Rumania).
For primary bibliographic entry see Field 02F.
W70-01908

2L. Estuaries

CARBONATE SEDIMENTS: ORIENTED LITHIFIELD SAMPLES FROM THE NORTH ATLANTIC,
Bedford Inst., Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.; and Queen's Univ., Kingston (Ontario). Dept. of Geological Sciences.
For primary bibliographic entry see Field 02J.
W70-01678

GEOCHEMISTRY OF DEEP WATERS AND OF THE ORGANIC MATTER IN THE NORTHERN PART OF THE G. D. R. (GERMAN),
Research Inst. for the Reconnaissance and Requirements of Petroleum and Natural Gas, Gommern (East Germany).
E. Peter Muller.
Russian and English summaries. Zeitschrift fur Angewandte Geol, Band 15, Heft 3, p 113-124, Mar 1969. 12 p, 13 fig, 5 tab, 31 ref.

Descriptors: *Geochemistry, *Deep water, Water chemistry, Organic matter, Sedimentary rocks, Groundwater, Saline water, Porosity, Geology, Stratigraphy, Carbonates, Brines, Chlorine, Potassium, Sodium, Calcium, Magnesium.
Identifiers: German Democratic Republic.

Saline waters of the German Democratic Republic were investigated for their salinity and organic matter contents to provide data for geochemical oil prospecting. The distribution and concentration of organic matter in the deep waters depends on the stratigraphy and lithological parameters of the formations. Analysis of deep waters found in the Strassfurt carbonate formation of Permian age is used to illustrate the influence on deep waters of the formation and diagenesis of the aquifer. (Gabriel-USGS)
W70-01680

SEDIMENTS OF THE ANDAMAN BASIN, NORTHEASTERN INDIAN OCEAN,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02J.
W70-01691

OPTIMIZING SEDIMENT SAMPLING PLANS,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-01870

MAN-MADE CARBON-14 IN DEEP PACIFIC WATERS: TRANSPORT BY BIOLOGICAL SKELETAL MATERIAL,
Scripps Institution of Oceanography, La Jolla, Calif.; and Tata Inst. of Fundamental Research, Bombay (India).
For primary bibliographic entry see Field 05A.
W70-01871

HOLOCENE INTERTIDAL CALCIUM CARBONATE CEMENTATION, QATAR, PERSIAN GULF,
Illing (V. C.) and Partners, Cheam (England).
J. C. M. Taylor, and L. V. Illing.
Sedimentology, Vol 12, No 1-2, p 69-107, Apr 1969. 39 p, 2 fig, 6 plate, 2 tab, 42 ref.

Descriptors: *Lithification, *Diagenesis, *Carbonate rocks, *Bottom sediments, Chemical precipitation, Water chemistry, Sea water, Carbonates, Calcite, Dolomite, Magnesium, Mineralogy, Petrology.
Identifiers: *Persian Gulf, Qatar, Aragonite.

Cemented layers in the shallow lagoonal, intertidal, and supratidal sediments surrounding the Qatar Peninsula, Persian Gulf, contain high-magnesian calcite and aragonite cements. The magnesian calcite appears to occur both as a primary precipitate and as a replacement of aragonite. These cements are believed to be forming today from sea-derived waters. Radiocarbon dating sets an upper age limit of about 4,500 years. Two major types of cemented layer can be distinguished: beachrocks form variably cemented units about 1 m thick at the surface of freely draining exposed beaches; cemented sheets a few cm thick form beneath the surface of broad intertidal sand flats by the growth, hardening, and coalescence of small friable lumps near low-tide level. Replacement of aragonite matrix, druse, and pellets by microcrystalline magnesian calcite is accomplished

by dissolution and reprecipitation; detail is obliterated but the gross features of the original fabric are preserved. The process helps to explain the crystal fabrics of many older limestones. (Knapp-USGS)
W70-01872

SUBMARINE LITHIFICATION OF HOLOCENE CARBONATE SEDIMENTS IN THE PERSIAN GULF,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (The Netherlands).
Eugene A. Shinn.
Sedimentology, Vol 12, No 1-2, p 109-144, Apr 1969. 36 p, 36 fig, 2 tab, 16 ref.

Descriptors: *Lithification, *Diagenesis, *Carbonate rocks, *Bottom sediments, Chemical precipitation, Water chemistry, Sea water, Sands, Carbonates, Calcite, Dolomite, Magnesium, Mineralogy, Petrology.
Identifiers: *Persian Gulf, Aragonite, Pore water.

Large areas of the sea floor in the Persian Gulf are composed of lithified carbonate sediment. That this cementation is contemporaneous and occurs within the present submarine environment has been proven by carbon dating, the presence of pottery and other artifacts within the lithified sediments, and other methods. Although the chemistry of the processes resulting in lithification is unknown it would seem not to require any special conditions other than carbonate-saturated sea water. The process seems to be operating in areas of relatively normal salinity and temperatures in depths ranging down to 30 m. It is deduced that the principal physical factors involved are relatively low rates of sedimentation, sediment stability, and high initial permeability of the sediments. The principal types of cement filling the intergranular spaces and locally replacing grains are aragonite (in several growth forms) and microcrystalline magnesium calcite. The aragonite cement seems to be unstable and has inverted locally to more stable calcite within the marine environment. Lithification results indirectly in the production of several other features all of which in the past have been regarded as criteria for unconformity. (Knapp-USGS)
W70-01873

GRAVELS OF THE SOUTHERN NORTH SEA,
Geological Inst., Groningen (Netherlands).
H. J. Veenstra.
Marine Geol, Vol 7, No. 5, p 449-464, Oct 1969. 16 p, 10 fig, 16 ref.

Descriptors: *Gravels, *Glacial drift, *Provenance, Sedimentation, Sampling, Mineralogy, Sediment transport, Pleistocene epoch.
Identifiers: *North Sea.

Gravels of six regions in the North Sea show differences in composition, grain size and roundness. The gravels in the Hinder Bank and Thames estuary regions represent reworked river deposits. The material near the Suffolk coast is better rounded and is a fossil beach gravel. These deposits were formed between Lower Tertiary and Lower Holocene. The gravel belt off the British coast contains many components that are not derived from rocks in the immediate surroundings. The gravels in the region of the Dogger Bank and Inner Well Bank Rough show analogous compositions pointing to a glacial origin. The gravel of the Dogger Bank was brought from the west by the land-ice of the Last Glacial. The gravel of the Cleaver Bank, east of the Dogger Bank, shows much flint of Scandinavian origin. The gravel of the Texel Rough is of Scandinavian origin, but here the moraines belong to the Saale (Penultimate) Glacial. Generally, the coarsest material is found on top of the elevations in the central North Sea, whereas more and finer gravel occurs in the deeper surroundings, thus indicating selection by waves during the low sea levels of the Lower Holocene. (Knapp-USGS)
W70-01874

THE ORIGIN OF HOLOCENE SHELL DEPOSITS IN THE CHENIER PLAIN FACIES OF ESSEX (GREAT BRITAIN),
Queen Mary Coll., London (England).
J. T. Greensmith, and E. V. Tucker.
Marine Geol, Vol 7, No 5, p 403-425, Oct 1969. 23 p, 11 fig, 38 ref.

Descriptors: *Sedimentation, *Shellfish, Sands, Currents (Water), Waves (Water), Sediment transport, Provenance, Aggradation, Erosion, Marine geology, Movement, Reefs, Sediment distribution.
Identifiers: *Cheniers, *Great Britain, Essex.

The chenier plain facies, extending 20 km northwards from the mouth of the Thames estuary, includes shell concentrations in the form of offshore banks and sheets with a maximum relief of 4 m, marsh edge sheets and ridges (cheniers) of lower relief, and shallow channel and pocket fills. Older inland shell deposits occupying the top 4m of a narrow 0.1-1 km wide zone running slightly oblique to the present coastline are predominantly degraded cheniers. They do not exhibit marked topographic relief. The modern cheniers are asymmetric bodies, crudely layered and crossbedded but devoid of imbricate structure. They are very mobile and migrate during storm periods across the salt marshes. The bulk of the shells are derived from living communities near low water mark and from sub-littoral communities, particularly those living in adjacent estuary channels. The history of the modern shell deposits since 1946 shows that their growth is largely dependent on two factors, mass mortality in the channel communities and the reworking of pre-existing shell sheets interbedded with mud-silt and fine sand of the intertidal zone. Sheets exposed at the salt marsh edge are important contributors at the present time. Growth is more pronounced during regional phases of tidal flat erosion. (Knapp-USGS)
W70-01875

A STUDY OF THE PHYSICAL HYDROGRAPHY OF THE PATUXENT RIVER AND ITS ESTUARY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Wadsworth Owen.
Res partly sponsored by Univ of Maryland, Natur Resources Inst. Chesapeake Bay Inst Tech Rep No 53, Johns Hopkins Univ, Apr 1969. 78 p, 26 fig, 2 tab, 20 ref, 2 append. Proj No NR 083-016, Contract Nos Nonr 248 (20) and Nonr 4010 (11), (Office of Naval Research).

Descriptors: *Hydrography, *Estuaries, *Rivers, *Maryland, *Stratified flow, Stratification, Salinity, Saline water intrusion, Water quality, Tidal effects, Water circulation, Streamflow, Dissolved oxygen, Hydrogen ion concentration.
Identifiers: Patuxent Estuary.

The Patuxent River, which has the largest drainage basin in the State of Maryland, is an estuary tributary to the Chesapeake Bay which itself is an estuary. A distinguishing feature of the Patuxent Estuary is its intermittent transition from a two-layer flow system to a three-layer flow system, a transition which occurs most often in the month of April. The data, for the most part, reveal the seasonal trends common to the other estuaries tributary to the Chesapeake Bay. The salinity is highest in the autumn months and lowest in the spring during the month of April. The water temperature follows the seasonal trends in the air temperature as might be expected for an estuary in a temperature climate. It seems reasonably certain that the three-layered flow which exists intermittently in the Patuxent is caused by a phase difference in fresh water inputs from the Susquehanna and from the Patuxent. (Knapp-USGS)
W70-01890

HYDROGEOLOGICAL RESEARCH IN THE DANUBE DELTA (ROMANIAN),
State Geological Committee, Bucharest (Rumania).
For primary bibliographic entry see Field 02F.
W70-01907

MODEL SIMULATION OF SALINITY INTRUSION IN TIDAL ESTUARIES,
University of Strathclyde, Glasgow (Scotland).
D. I. H. Barr.
The Engineer, Vol 216, p 885-893, Nov 29, 1963. 6 fig, 1 tab, 31 ref.

Descriptors: *Model studies, *Estuaries, *Tides, *Saline water intrusion, Froude number, Reynolds number, Thermal pollution.

The purpose of this study is to explain certain aspects of model simulation of natural phenomena. One of the aspects studied was the exaggeration of the vertical scale and why it is a theoretical as well as a practical necessity. Then, consideration was given the further complication involved when simulation of salinity intrusion is required in tidal models. Because there is a link between all model experiments involving extended gravitational flow - free surface or internal and steady state or non-steady state - and it is proposed that the most appropriate parameters for the correlation and comparison of results from differing examples of such studies are the Froude-Reynolds number and the densimetric Froude-Reynolds number. Some conclusions were: (a) The congruency diagram method of scaling for heat dissipation models is essentially a facet of the whole problem of the scaling of free surface models where head loss is important. (b) Need of the exaggeration of the vertical scale in extension models is fundamental. Exaggeration will always cause some distortion; the well-mixed type of intrusion is in many ways more amenable to the model study approach than the power-station heat dissipation problem. (Guerrero-Vanderbilt)
W70-01918

AMINO ACID LEVELS IN THE ARGENTINE BASIN SEDIMENTS: CORRELATION WITH QUATERNARY CLIMATIC CHANGES,
Illinois Univ., Urbana.
F. J. Stevenson, and C-N Cheng.
Journal of Sedimentary Petrology, Vol 39, No 1, p 345-349, 1969. 3 fig, 1 tab, 17 ref.

Descriptors: *Amino acids, *Sediments, *Quaternary period, Pleistocene epoch, Marine geology, Distribution patterns, Nitrogen compounds, Nitrogen cycle, Geochemistry, Cores, Soil chemistry.
Identifiers: *Argentine Basin, *Climatic changes, Pleistocene glaciation, Marine sediments, Chemical processes.

Studies of three cores of Argentine Basin sediments, approximately 850 to 1200 centimers in length, taken from 640 to 920 nautical miles offshore, showed a close correlation between variations in the depth distribution of amino acids (100-400 micrograms amino acid nitrogen/gram sediment) and climatic fluctuations resulting from Pleistocene glaciation. Except for the top layers, which are presumed not to have attained equilibrium levels, zones of highest amino acid accumulation corresponded to sedimentary material deposited during periods of maximum ice accumulation on the continents. The appearance of corresponding amino acid layers at shallower depths in sediments further away from the mainland is said to be due to slower sedimentation rates with increasing distance from the shore. Further explanations of the observed patterns are offered. (Browman-Wisconsin)
W70-01934

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

EFFECT OF SOIL MOISTURE REGIME AND ROW SPACING ON GRAIN SORGHUM PRODUCTION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
Z. Plaut, A. Blum, and I. Arnon.
Agronomy Journal, Vol 61, No 3, p 344-347, May-June 1969. 2 tab, 3 fig.

Descriptors: *Irrigation practices, *Semiarid climates, *Water conservation, *Sorghum, *Evapotranspiration, Crop production, Soil-water-plant relationships, Soil moisture, Crop response, Grains (Crops), Irrigation efficiency, Leaves, Moisture availability, Rates of application, Timing.
Identifiers: *Israel, Leaf area duration, Row spacing.

Grain sorghum is widely grown in arid and semiarid climates using irrigation agriculture. The authors of this article conducted an experiment using different irrigation regimes on grain sorghum production in semiarid central Israel. With heavier irrigation rates total evapotranspiration almost doubled, from 270 mm. to 530 mm. Total dry matter increased linearly with increased water use. However, a sigmoid relationship was found between grain yield and total evapotranspiration, indicating a decreasing rate if productivity when water was applied beyond a certain rate. The greatest water efficiency was with two irrigations to field capacity when the second was delayed until the milk stage of the crop. Changes in row spacing had little effect on yield. (Crouse-Arizona)
W70-01803

3A. Saline Water Conversion

PERFORMANCE OF POROUS CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF HARD AND WASTE WATERS,
Ottawa Pollution Control Center (Ontario); and National Research Council of Canada, Ottawa (Ontario). Div. of Applied Chemistry.
For primary bibliographic entry see Field 05D.
W70-01644

ELECTROSORPTION AND DESORPTION PROCESS FOR DEMINERALIZATION,
Southern Research Inst., Birmingham, Ala.
Robert E. Lacey.
Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 - Price $1.25 per copy. Office of Saline Water Res and Develop Progr Rep No 398, 1969. 117 p, 29 fig, 14 tab, 2 append. Contract No 14-01-0001-975 OSW.

Descriptors: *Desalination, *Desalination processes, *Adsorption, *Demineralization, *Membrane processes, Electrodialysis, Membranes, Brackish water, Water quality, Analytical techniques, Cost analysis, Cost comparisons.
Identifiers: *Electrosorption, *Desorption, Electrosorption membranes.

An improved design for electrosorption stacks, and methods of making acceptable electrosorption membranes have been developed. Operating characteristics of the improved electrosorption stack were determined in laboratory experiments and then the stack was used in the field to demineralize two types of natural brackish waters. The field evaluation unit was operated 24 hours a day for periods up to 54 days to determine the best operating conditions to be used with these natural waters. Electrodialysis experiments were conducted with the same waters. The data from the long-term evaluations of demineralization performance were used for estimating the cost of demineralizing these two waters by electrosorption and by electrodialysis. The cost estimates indicated the cost of demineralization by electrosorption would be lower than that for demineralization by electrodialysis by about 17% for one of the waters and about 6% for the other. (Carstea-USGS)
W70-01671

HYDRODYNAMIC STUDIES FOR ELECTRODIALYSIS,
McDonnell Douglas Astronautics Co., Newport Beach, Calif.
G. Belfort, and G. A. Guter.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 - Price $1.25 per copy. Office of Saline Water Res and Develop Progr Rep No 459, July 1969. 144 p, 87 fig, 15 tab, 14 ref. Contract No 14-01-0001-1313 OSW.

Descriptors: *Hydrodynamics, *Electrodialysis, *Desalination processes, Photography, Membranes, Brines, Ion exchange, Porosity, Flow, Electrical resistance, Screens, Head loss.
Identifiers: *Spacer screens, Drag coefficient.

The hydrodynamic effectiveness of various spacer screens for electrodialysis was studied with the aid of a novel photographic technique in which exposed photographic paper was used in the place of ion-selective membranes, and photographic developer was used in the place of brine. This technique produced a visual record of the membrane-solution interfacial flow patterns in electrodialysis cells. Additional tests were conducted on each screen with respect to porosity, dead flow area, drag coefficient, and influence on electrial resistance. Some screens are considerably more effective than others in improving electrodialysis performance, especially at flow rates that give Reynolds numbers greater than 180. Seven (out of 21) of the more promising screens were further evaluated in electrodialysis batch tests to determine how current efficiency, membrane stack pressure drop, and total power requirements vary with flow rate. Two new materials, not previously used in commercial electrodialysis equipment are recommended for further study. (Carstea-USGS)
W70-01672

CHEMICALS FROM SEA WATER BRINES,
Office of Saline Water, Washington, D.C.
Lee Leiserson, and Paul C. Scott.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 - Price $0.35 per copy. Office of Saline Water Res and Develop Progr Rep No 445, Aug 1969. 25 p, 5 tab, 29 ref.

Descriptors: *Sea water, *Desalination, Sodium chloride, Economics, Research and development, Saline water, Disposal, Elements (Chemical), Brackish water, Brine disposal.
Identifiers: *Mineral recovery.

The methods of recovery of chemicals from desalting plant effluents are reviewed. The production of saturated brine, sodium chloride, and other minerals from brine effluents can be of economical importance under appropriate conditions. The production requires relatively simple technology. Areas needing more research in economical recovery are outlined. (Carstea-USGS)
W70-01674

AN ECONOMIC AND ENGINEERING ANALYSIS OF THE ELECTRODIALYSIS PROCESS,
Bechtel Corp., San Francisco, Calif.
J. Winston Porter, and S. Clerney.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 - Price $2.50 per copy. Office of Saline Water Res and Develop Rep No 470, Aug 1969. 155 p, 22 fig, 25 tab, 9 ref, 4 append. Contract No 14-01-0001-1704 OSW.

Descriptors: *Electrodialysis, *Desalination, *Cost analysis, Pilot plants, Membranes, Computer programs, Economic efficiency, Membrane process, Water costs.
Identifiers: *Economic analysis, *Engineering analysis, Reinforced membrane.

The electrodialysis process was studied in plants of 1, 10, and 50 million gallons per day capacity, treating each of 3 reference brackish waters. The plants used both reinforced and unreinforced membranes. A computer algorithm was developed to perform necessary process and plant design calculations in order to provide capital and water costs for each plant. The calculated information includes: (1) the effect of power cost and feedwater temperature on desalted water costs; (2) an analysis of critical components and their effect on desalted water costs; and (3) the effect on desalted water costs of certain projected technology items. (Carstea-USGS)
W70-01675

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
James N. Butler.
Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 - Price $1.50 per copy. Office of Saline Water Res and Develop Progr Rep No 388, Oct 1968. 175 p, 40 fig, 18 tab, 133 ref. Contract No 14-01-0001-607 OSW.

Descriptors: *Electrodes, *Thermodynamics, *Reverse osmosis, *Desalination processes, Electrodialysis, Potassium, Calcium, Adsorption, Solvent extractions, Ion exchange.
Identifiers: *Amalgam electrodes, *Activity, Activity coefficients, Alkali metal electrode, Glass electrode, Electrosorption, Irreversible thermodynamics, Lithium.

The theory of irreversible thermodynamics is used to show the importance of activity as opposed to concentration in the electrodialysis and reverse osmosis processes in desalination. The discussion includes: (1) activity coefficient measurements in the aqueous multicomponent systems NaCl-Na sulfate, NaCl-LiCl; (2) thermodynamics and kinetics of the alkali metal amalgam electrode; (3) interference by a second cation such as potassium or lithium; (4) measurements of the standard potential of the lithium amalgam electrode; (5) the alkaline earth amalgam electrodes, particularly calcium and barium; and (6) techniques for handling amalgam electrodes, chloride and sulfate-reversible reference electrodes, glass electrodes and liquid ion exchange electrodes. The activity of individual components is important in solvent extraction, adsorption, electrosorption and scale formation. Activity measurements using a calcium-sensitive specific ion electrode are reported, and the theory of the activity of calcium ion in multicomponent solutions is discussed. A possible method based on the Bronsted theory for prediction of activity coefficients in multicomponent mixtures is presented. Experimental studies of the calcium amalgam and barium amalgam electrodes are summarized. (Carstea-USGS)
W70-01676

FREON-12 HYDRATE DESALTING PROCESS,
Mason-Rust, Lexington, Ky.
Kenneth Garrison, R. J. Slape, and L. L. Snedden.
Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 - Price $3.75 per copy. Office of Saline Water Res and Develop Progr Rep No 368, Aug 1968. 181 p, 17 fig, 6 chart, 21 photo, 2 tab, 61 ref. Contract No 14-01-0001-1179 OSW.

Descriptors: *Desalination processes, *Pilot plants, *Hydrates, *Sea water, *North Carolina, Desalination, Hydration, Brines, Filtration, Heat exchan-

gers, Instrumentation, Condensation, Research and development.
Identifiers: *Koppers hydrate process, Research and Development Test Station, Wrightsville Beach (NC).

This report summarizes the operational program conducted on the Koppers hydrate process at the Research and Development Test Station at Wrightsville Beach, North Carolina. The process studied consists of: (1) formation of gaseous hydrate in sea water; (2) brine removal from hydrate by filtration and washing; (3) decomposition by direct contact with condensing hydrating agent vapor, and (4) heat exchange with sea water. The hydrate process is technically feasible as shown by the fact that the 10,000 gpd plant operated without shutdown for 28 consecutive days. Production was approximately 300 gpd resulting in a product water of 101 ppm minimum salinity. Downtime was caused mainly by mechanical failures, lack of instrumentation, lack of control, and inadequate processing equipment. The hydrate pilot plant can be improved, and means of improvement are discussed. (Carstea-USGS)
W70-01677

CONCEPTUAL DESIGN STUDY OF A 50 MILLION GALLON PER DAY MSF DESALINATION PLANT AND TEST MODULE.
Fluor Cor., Ltd. Los Angeles, Calif.

OSW R and D Progr Rept No 233, Nov 1966. 97 p, 24 fig, 24 ref.
Identifiers: *Conceptual designs, *Flowsheets, *Multistage flash distillation, Capitalized costs, Construction costs, Cost breakdowns, Design, Layout, Plant layout, 0-50 MGD plant.

The purpose of the work is the development of a test module conceptual design from which architect-engineer plans and specifications may be prepared for procurement and construction. The evaporator unit described employs the conventional multistage flash process. The plant consists of 39 stages, 36 recovery stages and 3 rejection stages, and operates with a maximum brine temperature of 250 deg F. Blowdown brine concentration ratio is 2.0. Concentration ratio of the brine circulated through the brine heater is 1.7. Design capacity is 50 mgd of potable water at 78 deg F. The test module width was influenced by the desire to be able to demonstrate in the module the same size brine circulation pump as selected for the 50 mgd design. Considering all factors led to the use of a 1/4 width test module.
W70-01703

OPTIMIZATION OF FLASH DISTILLATION PLANTS FOR SEA-WATER CONVERSION,
Haschinenfabrik Augsburg-Nuernberg A. G., Gustavsburg (West Germany).
For primary bibliographic entry see Field 07C.
W70-01705

AN ASSESSMENT OF VAPOR COMPRESSION DISTILLATION,
California Univ., Richmond.
B. W. Tleimat, E. D. Howe, and A. D. K. Laird.
Desalination 2, p 287-98, 1967. 12 fig, 6 ref.
Identifiers: *Compressors, *Vapor compression evaporation, *Vapor compressors, Bench scale, Component designs, Design data, Distillation processes, Falling film evaporation.

A description of tests and data are presented concerning vapor compression distillation. It is shown that the compression energy requirement for the vapor-compression cycle may be predicted from the isentropic compression work requirement. The compressor energy is a function of M (the circulation ratio, lbs brine/lbs product), and decreases with increasing M. The isentropic compression work is higher for a finite M than that required by the conventional compression cycle. Methods are presented for estimating the effects of salinity and other factors on compressor power requirements.
W70-01706

PREVENTIVE FOR SCALING AND CORROSION OF FLASH EVAPORATORS,
Tokyo Electric Power Corp. (Japan); Mitsubishi Heavy Industries Ltd., Tokyo (Japan).
For primary bibliographic entry see Field 08G.
W70-01707

COMBINED SYSTEM FOR THE OPTIMUM SATISFACTION OF SIMULTANEOUSLY ARISING DEMAND FOR FRESHWATER AND ELECTRICAL POWER,
Hoterv, Budapest (Hungary).
For primary bibliographic entry see Field 08C.
W70-01708

STUDY OF THE BEHAVIOUR OF VARIOUS MATERIALS IN SEA WATER UP TO 150 DEG C,
Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
For primary bibliographic entry see Field 08G.
W70-01709

THE CHARACTERISTICS OF DUAL PROCESS DISTILLATION PLANT COMBINING VAPOUR COMPRESSION AND MULTI-STAGE FLASH EVAPORATORS,
Atomic Energy Research Establishment, Winfrith (England).
F. C. Wood, and R. Herbert.
Preprint of Paper SM-113/44 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 23 p, 7 fig, 6 ref.
Identifiers: *Coupling (Reactor-desalting plant), *Dual-purpose plant, *Multistage flash distillation, *Vapor compression evaporation, Evaporators, Flash evaporation, Flowsheets, Heat exchangers, Heat transfer surfaces, Multiple effect distillation, Single-purpose plant, Thermodynamics, Turbines, Water costs estimate.

The relationship of energy demands and heat transfer surface for the vapor compression process are examined from the thermodynamic standpoint and compared with those of other evaporation processes. It is concluded that the greatest advantage in terms of heat transfer surface per unit of prime fuel is obtained when the vapor compression evaporator is coupled to the top end of the multistage flash plant either in single- or multi-effect. Various alternative coupling modes are considered, including the use of a secondary fluid in the vapor compression work cycle. Relative outputs of vapor compression and multistage evaporators depend primarily upon the type of heat source available and the efficiencies of the heat and work cycles. Typical figures are presented for various combinations using boilers/steam turbines, gas turbines, diesels and jet compressors. The principal secondary variables are operating temperature differences across the two kinds of evaporators. Power-to-water ratio may be increased economically by using a portion of the energy produced at the steam turbine to drive the vapor compression evaporator. The influence of the choice of principal variables, including turbine pass-out pressure, upon operating costs is illustrated for a nominal 300 mw (e) advanced gas cooled reactor operating in dual- and single-purpose modes.
W70-01710

THE STEAM-GENERATING HEAVY-WATER REACTOR IN DUAL-PURPOSE APPLICATIONS,
Atomic Energy Research Establishment, Winfrith (England).
For primary bibliographic entry see Field 08C.
W70-01711

SOME BASIC ASPECTS OF THE FLASH DISTILLATION PROCESS,
Heriot-Watt Univ., Edinburgh (Scotland).
A. N. Dickson, and J. K. Bradie.
Preprint of Paper SM-113/46 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1969. 18 p, 9 fig, 26 ref.
Identifiers: *Demisters, *Multistage flash distillation, *Two-phase flow, Entrainment, Evaporators, Experimental data, *Flash evaporation, Fluid flow, Hydraulic structures, Research results.

A report on MSF research at Heriot-Watt University. Part I discusses the problem of entrainment of water droplets in vapor streams and their removal by wire mesh type demisters. Methods of measuring droplet size-frequency spectra are given together with typical spectra obtained from an air-water analogue of pool boiling. Mesh demister performance is analyzed and collection efficiency of a wire discussed. Experimental measurements of dry pressure drop through demisters are given and a correlation derived from a simple physical model is suggested. The physical model is developed to provide a correlation between liquid and vapor flow rates at the point where flooding of the demister occurs, and this is compared with experimental results. Some discussion of wet pressure drop is also given. Part II presents experimental and analytical results of two-phase flashing flow in pipes and channels. The analysis is based upon a finite rate of vaporization model, which does not assume that thermodynamic equilibrium obtains, and allowance is made for variable vapor/liquid velocity ratios. Consideration is restricted to the two-phase flow regime in which the vapor is dispersed as bubbles throughout the liquid. The phenomenon of hydraulic jump in two-phase channel flow is discussed and both experimental and analytical results are given.
W70-01712

EXERGY LOSSES IN A FLASH EVAPORATOR,
Technische Hogeschool, Delft (Netherlands).
L. W. Koot.
Desalination 5, p 331-48, 1968. 8 fig, 7 ref.
Identifiers: *Multistage flash distillation, *Thermodynamic analysis, Distillation processes, Flash evaporation, Heat loss, Thermodynamics.

A thermodynamic explanation of the operation of a flash evaporator by the principle of exergy losses is of considerable importance, especially in the study of the desalination process. In a flash evaporator an amount of circulating heat to which additional energy is supplied is subjected to the irreversibilities of the installation. A calculation of the losses of exergy and measures of these irreversibilities, give information about the process details which are mainly responsible for the energy consumption. Assuming some simplifications, the numerical values of the loss of exergy are calculated for the special case of a ten stage once-through flash evaporator. It is found that the dominant losses are caused by the irreversibilities of the heat transfer from steam to brine and by the isenthalpic expansion of the brine between the flash chambers. Significant to cost reduction may be the need to supersede the flashing process by one involving less entropy production. This may be accomplished by (1) reducing losses in the water-steam separator, (2) restricting pumping power, (3) economical removal of incondensables.
W70-01713

UNITED KINGDOM DESALINATION RESEARCH AND DEVELOPMENT PROGRAM,
United Kingdom Atomic Energy Authority, Risley (England).
H. Kronberger.
Preprint of Paper SM-113/50 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 6 p.
Identifiers: *Development, Distillation processes, Freeze processes, Membrane processes, Multistage flash distillation, *Research, *Reviews.

In 1965 the Ukaea, on behalf of the UK government, assumed responsibility for research into development of methods of desalination of salt water. An initial three-year program costing $3 million brought close collaboration with industry on

processes including multistage flash distillation, electrodialysis, the secondary refrigerant processes and reverse osmosis. The program had two principal objectives - (1) to exploit the development potential of the multistage flash distillation process, and (2) to explore alternative methods of desalination which might supersede msf in the long term. In 1968 approval was given for expenditure of a further $9.6 million for the period 1968-71. Almost half of this will be used to finance agreed programs of work by the AEA with industrial collaborators. Project organization and current and proposed areas of research and development are outlined.
W70-01714

THE PHYSICS OF DESALINATION BY MULTI-STAGE FLASH DISTILLATION,
Glasgow Univ. (Scotland).
R. S. Silver.
J Brit Nucl Energy Soc 7 (1), p 36-42, 1968.
Identifiers: *Evaporator system design, *Physical properties, *Research, Bubble dynamics, Dynamic characteristics, Economic evaluations, Flash evaporation, Fluid dynamics, Performance ratio, Reviews, Stability analysis, Thermal properties, Vapor release rate, Water costs estimate.

The decision to utilize seawater conversion plants is based on economics. The costs involved are determined largely by knowledge of the related physical phenomena and by implementation of this knowledge. A review is presented of the major physical aspects and their interaction with plant design and cost. These aspects include bubble nucleation and growth, droplet formation, flashing temperature ranges, residence time, system stability and control, equilibrium time, and evaporation rate as related to thermal conductivity.
W70-01715

OPTIMIZATION OF MULTI-STAGE FLASH EVAPORATION PLANTS,
Alexandria Univ. (Egypt); and Atomic Energy Commission, Cairo (Egypt).
M. A. Mandil, and E. E. Abdel-Ghafour.
Preprint of Paper SM-113/67 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 25 p, 8 fig, 7 ref.
Identifiers: *Multistage flash distillation, *Parametric studies, *Thermodynamics, Brine concentration ratio, Design criteria, Distillation processes, Economic evaluations, Energy costs, Flash evaporation, Performance ratio, Thermodynamic analysis.

Principal optimization variables considered are number of stages, terminal temperature difference, performance ratio and concentration ratio. Interrelations between optimization variables are formulated by reference to interaction between thermodynamics and economics. A new concept of minimum-possible energy requirement is introduced, making it possible to account for the effect of brine concentration on amount of energy required and leading to a more accurate method of determining optimum concentration ratio. Thermal driving force function, providing a convenient interrelation between energy and surface requirements, is defined. The theory uses relative values of economic parameters rather than absolute values and, while current theories take economic parameters as constants, the proposed theory imposes no such restriction. As a result of its application, plots are furnished which can readily be used to determine optimum operating conditions represented in the concentration ratio, as well as design features such as number of stages, heating surface and energy requirement at optimum conditions.
W70-01716

DETERMINING THE OPTIMUM NUMBER OF STAGES OF THERMAL DESALINATION PLANT WITH SURFACE-TYPE EVAPORATORS,
Akademiya Nauk SSSR, Moscow. Moskovskii Inzhenerno-Fizicheskii Institut.
B. N. Golubkov, and A. I. Korneichev.
Thermal Eng, English Transl 14, p 69-72, 1967. 3 fig.
Identifiers: *Evaporator system design, *Evaporator-condenser system designs, *Vertical tube evaporators, Design, Distillation processes, Economic evaluations, Plant layout, Surface boiling.

An analytical method is developed for determining the optimal number of stages in desalination plants with surface-type evaporators. The method utilizes as input data on water and stream properties, operating temperatures and flow rates, condenser surface areas and performance factors, on stream time fraction, heat input, and costs of capital equipment, energy, amortization, labor, and maintenance.
W70-01717

THE SELECTION OF NUCLEAR POWER AND DESALINATION PLANTS FOR AUGMENTING EXISTING WATER RESERVES,
Associated Nuclear Services, London (England).
For primary bibliographic entry see Field 03E.
W70-01718

A SURVEY OF PRESENT AND FUTURE DESALINATION PROCESSES,
Atomic Energy Research Establishment, Harwell (England).
K. D. B. Johnson.
J Brit Nucl Energy Soc 7 (1), p 27-35, 1968. 8 fig, 21 ref.
Identifiers: *Economic evaluations, *Reviews, *Water costs estimate, Distillation processes, Electrodialysis process, Freeze processes, Membrane processes.

A summary of the trend evident in flash distillation plant development and against that background a discussion of the potential of competitive or alternative processes, particularly freezing, reverse osmosis, and electrodialysis both in the UK and overseas. At present flash distillation is in a commanding position, but there are reasons for believing that other processes are capable of development to the point where they will replace distillation in many circumstances.
W70-01719

THE NEED FOR DESALINATION,
Water Research Association, Medmenham (England).
R. G. Allen.
J Brit Nucl Energy Soc 7 (1), p 21-26, 1968. 4 fig, 5 ref.
Identifiers: *Multistage flash distillation, *Reviews, *Water utilization, Base-load, Distillation processes, Water sources, Water storage.

Desalination is in the early stages of its development as a water resource. It is already making its contribution as a straight addition to the water supply in cases where there is an absolute water deficiency, and it is now coming into use in areas where further conventional water supplies would be expensive, as the most economical supplement to existing systems. In the United Kingdom desalination as a base-load resource is considered unlikely before 1990, but its earlier application for peak load operation is expected. The world demand for desalination plants is thus expanding rapidly. The most successful process for seawater conversion remains multistage flash distillation, judged on both technical and economic grounds, and this advantage is likely to be retained for some time.
W70-01720

CONDENSER TUBE MATERIALS FOR SEA-WATER SERVICE,
Naval Ship Research and Development Lab., Annapolis, Md. Annapolis Div.
For primary bibliographic entry see Field 08G.
W70-01721

EVALUATION OF BRINE DESULFATING PROCESS AS APPLIED TO DESALINATION PHASE 1,
Catalytic Construction Co., Philadelphia, Pa.
For primary bibliographic entry see Field 05D.
W70-01722

DEVELOPMENT OF AN ANALYTICAL MODEL OF A FLASH STAGE - PART 1,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 08B.
W70-01723

GAS-TURBINE AND DIESEL-DRIVEN VAPOR-COMPRESSION DESALTING PLANTS,
Oak Ridge National Lab., Tenn.; and Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 08C.
W70-01724

DESIGN OF A 250-MGD VERTICAL-TUBE EVAPORATOR FOR SEAWATER DESALTING,
Oak Ridge National Lab., Tenn.
R. P. Hammond, I. Spiewak, and E. C. Hise.
IN Proc Western Water Power Symp, Los Angeles, Apr 1968. Western Periodicals, North Hollywood, Calif, 1968. p C-51-57, 3 fig, 6 ref.
Identifiers Conceptual design, Falling film evaporation, Flash evaporation, Vertical tube evaporators, 51-250 MGD plant, Capitalized costs, Concrete construction, Dual-purpose plant, Dual-purpose plant economics, Economic evaluations, Energy costs, Fabrication methods, Fixed charge rate, Heat transfer surfaces, Multiple effect distillation, Multistage flash distillation, Nuclear energy sources, Operating costs, Performance ratio, Synthetic resinsPlastics, Thermodynamics.

Under OSW sponsorship, ORNL prepared a conceptual design of a 250-mgd plant combining 15 effects of vertical tube, falling film evaporator with 50 stages of flash evaporator feed heating. The vertical tube surface is of the doubly fluted type, providing heat fluxes 2 to 3 times those of smooth tubes, and permitting design of a compact, closely coupled evaporator configuration. Additional economies are achieved by use of concrete structures and plastic materials. A preliminary investigation of several proposed processes, heat transfer surfaces, plant configurations, materials, and fabrication methods was made in sufficient depth to select those best suited to this specific set of circumstances. The combined multiple-effect multistage flash process chosen is thermodynamically more efficient (provides more water for a given operating temperature range) than either process on its own. Choice of a performance ratio of 13 lb/1000 btu was predicated upon the evaporator being coupled to a nuclear generator plant for the simultaneous production of water and power. The paper presents estimated capital and operating costs over a range of energy costs, fixed charge rates, and performance ratios. The conceptual design presents a strong economic incentive to pursue the development of vertical tube evaporator technology.
W70-01725

ADVANCES IN VERTICAL TUBE PLANTS FOR SEA WATER DISTILLATION,
Stearns-Roger Corp., Denver, Colo.
D. D. Kays.
IN Proc Western Water Power Symp, Los Angeles, Apr 1968. Western Periodicals, North Hollywood, Calif, 1968. p C-59-85, 6 fig.
Identifiers: *Falling film evaporation, *Multiple effect distillation, *Multistage flash distillation, *Vertical tube evaporators, Distillation processes, Dual-purpose plant, Flash evaporation, Heat recovery system.

A brief history of modern distillation development is combined with a summary of the current state of the art relative to the multiple-effect-vertical-tube seawater distillation process. Advanced designs possible with (1) extended surface falling film

tubes and (2) multiple stage flash heat recovery within each effect are developed analytically and described qualitatively. Progress design considerations for utilizing these concepts are presented. The overall technical advantage of the vertical tube distiller is shown by a direct comparison to the MSF recycle plant. The ease with which the vertical tube plant may be designed for large capacities is discussed. A few of the desirable features of coupling a VTE distiller to a nuclear fuelde power plant are presented.
W70-01726

CUPRO NICKEL ALLOYS FOR DESALINATION PLANTS,
American Brass Co., Waterbury, Conn.
For primary bibliographic entry see Field 08G.
W70-01727

THE CUPRO-NICKELS IN DESALINATION PLANT,
International Nickel Co., Ltd., London (England); and International Nickel Co., Inc., New York.
For primary bibliographic entry see Field 08G.
W70-01728

CALCIUM SULFATE SCALING IN SALINE WATER DISTILLATION,
Monsanto Research Corp., Everett, Mass.
For primary bibliographic entry see Field 05D.
W70-01729

ION EXCHANGE PRE-TREATMENT FOR SEA WATER DESALINATION PLANTS,
Maschinenfabrik Augsburg-Nuernberg A.G., Gustavsburg (West Germany).
For primary bibliographic entry see Field 05D.
W70-01730

STUDY OF TWO-PHASE METASTABLE FLOW,
Foster Wheeler Corp., Carteret, N.J.
R. W. Bryers, and W. S. Hsieh.
OSW R and D Progr Rept No 234, Nov 1966. 150 p, 46 fig, 4 tab, 20 ref.
Identifiers: *Fluid flow, *Two-phase flow, Flow distribution, Fluid dynamics, Fluid mechanics, Multistage flash distillation, OSW sponsored, Turbulent flow, Water flow.

An experimental study was made to determine the flow rate of saturated water through short tubes of various lengths and diameters. Tubes of both rounded and sharp edge entrances were tested in the horizontal and vertical positions. It was found that the fluid passed through the aperture in the metastable state. Critical flow rates existed for all test runs. The critical mass flow rates were dependent on both the length and the diameter of the tubes instead of the length to diameter ratio alone. The critical mass flow rate was found to be proportional to the ratio of the specific volume of the vapor and liquid to the .630 power and the aperture volume to the .163 power. Test results were analyzed and correlated. The flow patterns within the test tube were photographed by a high-speed movie camera to obtain a qualitative interpretation of the two-phase fluid flow.
W70-01753

SECOND REPORT ON THERMOPHYSICAL PROPERTIES OF SALINE WATER SYSTEMS,
Monsanto Research Corp., Everett, Mass.
B. M. Fabuss, and A. Korosi.
OSW R and D Progr Rept No 249, 1967. 50 p, 18 tab, 5 fig, 36 ref.
Identifiers: *Physical properties, *Viscosity, OSW sponsored, Thermal properties, Thermodynamics.

Viscosities of water solutions of sodium chloride, potassium chloride, magnesium sulfate, and sodium sulfate and their ternary combinations were measured in the 25-150 deg C temperature range. The concentration ranges covered corresponded to seawater and its concentrates up to a concentration factor of five. On the basis of this work a new correlation was developed for calculating the dynamic viscosity of liquid water. Preliminary work on thermal conductivity measurements is outlined. This is continuation of work covered in CSW R and D nos. 136 and 189.
W70-01754

INVESTIGATION OF CORROSION IN HOT SEA WATER IN AN EXPERIMENTAL LOOP APPARATUS,
Battelle Memorial Inst., Columbus, Ohio.
F. W. Fink, E. L. White, and W. K. Boyd.
OSW R and D Progr Rept No 225, Dec 1966. 30 fig, 9 tab, 3 ref.
Identifiers: *Corrosion tests, *Low alloy steels, *Nickel alloys, *Pitting (Corrosion), *Stainless steels, *Titanium, *Tubing (Metal), Aluminum alloys, Carbon steels, Concentration cell corrosion, Deaeration, OSW sponsored, Removal from feedwater, Carbonate, Scale prevention, Stress corrosion, Temperature control, Velocity control, Wrightsville beach plant.

An experimental program was undertaken at Wrightsville beach to study scale control and corrosion of metals in deaerated seawater to 300 deg F. Test materials included carbon and low-alloy steels, stainless steels, and nickel- and aluminum-base alloys. Performance of loop-component materials is given. Acid treatment to remove carbonate ion resulted in minor scaling at 250 deg F. In seawater at neutral pH, corrosion was minimized under carbonate-free conditions. All metals showed general or localized attack under certain conditions. Corrosion rate of steel was accelerated by temperature even at low oxygen levels. Low-alloy steels exhibited more tendency to pitting. Straight chromium steels were subject to severe pitting. Austenitic stainless steels and some high-nickel alloys showed excellent resistance at velocities of 5 ft/sec or greater. Under stagnant conditions or at crevice areas, however, pitting was encountered. At 250 deg F aluminum alloys performed poorly after two weeks. Titanium heat-exchanger tubing exhibited excellent resistance but was prone to crevice attack. Hastelloy C performed well as equipment components except in the pump where cracking occurred, presumably due to weld repairs or faulty design. Corrosion rates for test materials are given as a function of temperature, time, and velocity.
W70-01755

THE FRENCH PROGRAM FOR THE DESALINATION OF SEAWATER,
Centre d'Etude de l'Energie Nucleaire, Grenoble (France).
P. Balligand.
Preprint of Paper SM-113/72 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 7 p.
Identifiers: France, Research, Reviews.

A brief outline of the areas of desalination research and development under investigation by various industrial and governmental groups in France. A large portion of the work is being done under the direction of the French AEC. (In french)
W70-01756

FIFTEEN YEARS OF PROGRESS,
Department of the Interior, Washington, D.C.
M. N. Edwards.
Preprint of Paper SM-113/53 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 9 p.
Identifiers: *Reviews, Agriculture, Distillation processes, Dual-purpose plant, Energy sources, Freeze processes, Industries, Membrane processes, Nuclear energy sources, Research results, Single-purpose plant.

The U.S. Congress in 1952 enacted legislation authorizing a research program for development of practicable low-cost means of producing from seawater, or other saline waters, water of a quality suitable for agriculture, industrial, municipal and other beneficial consumptive purposes. With an initial appropriation of $175,000, the Secretary of the Interior established the Office of Saline Water. The U.S. Desalting Program has received continuing and increasing support by Congress. In 1968, the OSW appropriation for research and development activities was $24.5 million, bringing the total U.S. Government investment in desalting technology to more than $130 million. This paper reviews the status of desalting technology when the U.S. program was initiated and reports on major activities achieved since then. The current status of freezing methods and membrane processes is discussed, but major emphasis is on the present state-of-the-art of distillation techniques and the utilization of nuclear reactors as an energy source for multimillion gallons-per-day water-only or dual-purpose power and water plants.
W70-01757

UNITED KINGDOM APPROACH TO DESALINATION AND NUCLEAR POWER,
Atomic Energy Authority, Risley (England).
H. Kronberger.
Preprint of Paper SM-113/71 Presented at IAEA Symp Nucl Desalination, Madrid, Nov 18-22, 1968. 7 p.
Identifiers: *Dual-purpose plant, *Multistage flash distillation, Flash evaporation, Freeze processes, Membrane processes, Pilot plant operations, 0-50 MGD plant.

The first phase of the UK National desalination program was initiated in 1965 for a 3-yr period with a government appropriation of $3 million. Responsibility was vested in the Ukaea, with two objectives - (1) to further development of the multistage flash process and (2) to explore alternative processes which might supersede MSF. The first objective was pursued in close collaboration with Weir Westgarth Ltd., while the second was begun solely as a Ukaea responsibility, with alternatives reduced to freezing, electrodialysis, and reverse osmosis. Industrial collaborators have been named for these processes. Most of the first-phase budget was directed toward MSF development. A new seawater experimental establishment was constructed by Weir Westgarth at Troon, Scotland, with facilities to test plant features up to 10 MGD in size. Large-scale facilities are also being operated, or are under construction, in industrial laboratories for electrodialysis and freezing. A second 3-yr program was authorized in 1968, at a cost of $9.6 million. A new contract is being placed with Water Research Association to extend their work on conjunctive use of desalination and conventional water supply to specific problems of such use in other countries.
W70-01758

EVAPORATION COEFFICIENT OF LIQUIDS,
Rochester Inst. of Tech., N.Y.
J. R. Maa.
Ind Eng Chem Fundamentals 6, 504-18, 1967. 8 tab, 24 fig, 15 ref.
Identifiers: *Film evaporation, *Heat transfer, *Heat transfer coefficient, Conduction (Heat), Heat exchangers.

Thermal gradient calculations have been made in an attempt to place the technique of the jet tensimeter on a quantitative basis. Families of curves have been derived with which experimental data can be compared. Using the jet tensimeter, evaporation rates of water, isopropyl alcohol, carbon tetrachloride, and toluene have been examined at various liquid temperatures, times of exposure, and back pressures of vapor. The experimental results agree satisfactorily with the thermal gradient calculations, making the assumption that the evaporation coefficient is unity. This shows that there is little or no resistance to molecules crossing the vapor-liquid interface in addition to the natural resistance imposed by the gas laws. As a corollary, when any vapor molecule strikes at the interface,

the chance of failing to cross is small. No significant difference in the behavior of evaporation due to the difference in molecular structure or chemical properties was observed.
W70-01759

PRACTICAL CONSIDERATIONS IN DESALTING AND ENERGY DEVELOPMENT AND UTILIZATION,
Atomic Energy Commission, Washington, D.C.
J. T. Ramey.
Preprint of Paper SM-113/70 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 16 p, 7 ref.
Identifiers: *Dual-purpose plant economics, *Nuclear energy sources, *Water utilization, Base-load, Dual-purpose plant, Economic evaluations, Energy sources, Nuclear desalination, Peaking power, Water costs estimate.

The combination of nuclear power and desalting in large dual-purpose installations tends to maximize economics inherent in large-scale operation. Water costs of 30-40 cents/1000 gal from large (100 mgd-300 mwe) plants appear to be achievable in plants of the near future. Technological advances will further reduce this cost, making the long-range economic outlook for large-scale desalting quite favorable. Combining production of water and electric power requires planning for development of both resources. Various approaches to unified resource development may be taken, including consideration of peak vs base load power requirements, use of hydro-power to supplement power from the dual-purpose plant in peak periods, and ability to store desalted water in existing facilities. These factors also introduce a need to carefully assess values assigned to the two products. Application of nuclear desalting to the energy center concept is essentially tailored to special problems and opportunities of developing nations. Factors which must be considered are complex and diverse, including such elements as water and power demands, agricultural production and marketing, industrial capabilities and the market for manufactured products, as well as financial and even sociological considerations.
W70-01760

VALUE TO AGRICULTURE OF HIGH-QUALITY WATER FROM NUCLEAR DESALINATION.
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 03C.
W70-01761

THE RESULTS OF SOVIET RESEARCH ON DESALTING OF WATER,
Desert Inst., Ashkhabad (USSR).
M. V. Kolodin.
Translation from Problemy Osvoyeniya Pustin No 6, p 33-41, 1967. Soviet Geography: Review and Translation, Vol 9, No 6, June 1968, p 493-502, 1 tab, 16 ref.

Descriptors: *Desalination, *Desalination plants, *Scaling, *Arid lands, *Economics, Desalination processes, Distillation, Freezing, Flash distillation, Electrodialysis, Solar distillation, Boiling, Saline water, Costs.
Identifiers: *USSR, Natural freezing.

The author reviews saline-water conversion progress and lists plants installed or planned for installation in the USSR. The technical characteristics and costs per unit of converted water are summarized. Costs range from an estimated 0.06 rubles per cubic meter for a dual purpose atomic energy plant under construction in the Kazakh SSR to 14.60 rubles per cubic meter for a small straight distillation plant built in 1907 in Turkmenia. The conclusion is that considerable success has been achieved in design of large scale plants but a great need exists for small stationary and portable units for use in rural areas. (Crouse-Arizona)
W70-01824

FLOW THROUGH POROUS MEDIA: A STATISTICAL APPROACH,
Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
Ruth H. Aranow, and Louis Witten.
Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 - Price $0.40. Office Saline Water Res and Develop Progr Rep No 354, Aug 1968. 31 p, 19 ref, 1 append. Contract No 14-01-0001-411 OSW.

Descriptors: *Ion transport, *Membrane processes, *Flow, *Porous media, *Statistical models, Statistical methods, Membranes, Fluid friction, Immiscibility, Equations, Thermodynamics, Hydrodynamics, Desalination processes, Desalination.
Identifiers: Immiscible fluids, Miscible fluids, Multicomponent fluid systems, Irreversible processes, Charged membranes.

The statistical mechanical treatment of ion transport processes in multicomponent fluid systems developed by Bearman and Kirkwood is adapted to include flow in porous media. The rigid medium is treated as if it were one of the components of the multicomponent fluid system, but it is constrained by an external force which prevents its motion. Various equations are presented which clarify the problem of 'fingering' at the displacement front between two immiscible fluids in the membrane. The equations lead under restrictive conditions to the same results as the theoretical developments of Scheidegger and Brinkman. New equations for flow in miscible multicomponent systems are suggested. Darcy's constant is given a statistical interpretation in terms of pair correlation functions through the definition of the friction coefficient. The development also serves as a connecting link between hydrodynamics in porous media and the thermodynamics of irreversible processes. (Carstea-USGS)
W70-01886

RATIONALE FOR LOW-COST NUCLEAR HEAT AND ELECTRICITY,
Oak Ridge National Lab., Tenn.
J. A. Lane.
In: Abundant Nuclear Energy, Proc Sym Gatlinburg, Tenn, Aug 1968. Published in AEC Symp Ser 14, (CONF-680810), p 3-28, 1969. 11 fig, 15 tab, 9 ref.
Identifiers: *Energy costs, *Nuclear energy sources, Breeder reactors, Converter reactors, Energy sources, Process heat.

A review of the historical use of energy reveals that the amount used by any one person is strongly dependent on its cost. An extrapolation of this trend to the year 2000 results in a projection that the average delivered cost of electricity in the U.S. will decrease to 3.5 mills/kwhr and the per capita consumption will increase to 30,000 kwhr per annum. Achieving such low-cost power will require significant improvements in generating costs, as well as reductions in transmission and distribution costs. This paper describes in some detail how this might be done. Generating costs, for example, will be reduced to about 1.5 mills/kwhr through the development of very large (i.e., 5000-mwe) high-performance breeders served by large-scale fabrication and processing plants. Nuclear plants with such characteristics appear to be an achievable end product of the present lines of nuclear power development. If the sale price of electricity is properly assigned to various types of customers as a function to the amount used by each customer, an average delivered price of 3.5 mills/kwhr would result in a rate of 5.5 mills/kwhr for residences and 1.5 mills/kwhr for industries. These prices will be low enough to stimulate an electricity binge on the part of both the household user and new industrial users.
W70-01946

INTEGRATION OF WATER REQUIREMENTS IN ARID AREAS BY MEANS OF DUAL-PURPOSE PLANTS FOR THE DESALINATION OF SEA WATER AND PRODUCTION OF ELECTRIC POWER. OPERATIONAL RESULTS OBTAINED BY THE ITALSIDER PLANTS AT TARANTO, ITALY (IN ITALIAN),
Societa Italiana Implanti, Genoa.
G. Carolei, C. Franzosi, and M. Jemma.
Preprint of Paper SM-113/3 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 21 p, 3 fig, 6 ref.
Identifiers: *Dual-purpose plant, *Flash evaporation, *Operating experience, Corrosion problems, Dual-purpose plant economics, Energy sources, Operating costs, Scaling, Turbine driven pumps, Turbine-generators.

The plants are considered in a dual-purpose context and the relevant heat cycle efficiencies are considered. An overall increase in efficiency is noted when compared with plants for desalination only. An economic advantage lies in the possibility of selling the electrical power produced at the same time as the fresh water. These plants are thus well suited to regions of rapid industrial and social development which are also near large settlements of the agricultural and residential type. The large flash evaporation units installed in the Italsider iron and steel works at Taranto can also be considered as dual-purpose plants since they utilize exhaust steam which has already undergone two enthalpy steps, first in the turbo-alternators at the thermoelectric station, and then in two turbopumps. In connection with the latter installation, the authors analyze the operational results and steps taken to solve problems of scaling and corrosion, as well as problems caused by the presence of metal ions in solution in the product water, some of which is intended for use in high-pressure boilers.
W70-01947

INTEGRATING DUAL-PURPOSE PLANT FOR POWER AND WATER PRODUCTION INTO AN EXISTING ELECTRICITY SUPPLY SYSTEM,
Electro-Watt Engineering Services Ltd., Zurich (Switzerland).
K. Goldsmith.
Preprint of Paper SM-113/42 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 10 p, 3 fig.
Identifiers: *Dual-purpose plant, *Load following, *Peaking power, *Product ratio, Base-load, Dual-purpose plant economics, Economic evaluations, Energy sources, Load factor, Nuclear energy sources, Plant factor, Process heat, Reactor power cycle, Steam cycle, Water storage.

The operating regime demanded of various types of generating plant is illustrated with reference to daily and annual load curves of typical supply systems in areas of potential water shortage. It is shown that, if a particular dual-purpose plant exceeds a critical size, which may be less than its optimum size, it will be of maximum value to the system if its power output can be cyclically or seasonally varied to suit system requirements. Water production costs from this plant will then be lowest. Thus, with a constant amount of heat produced by boiler or reactor, the heat/power ratio on the generating side may have to be altered, in the short term to keep it in step with the system load curve and in the long term to accord with the changing position of the power plant in the general order of merit of all other generating plant in the system. Water is then produced counter-cyclically, i.e., at a maximum rate at times of minimum power demand, any temporary water surplus being stored. Steam cycles for varying heat-power ratios are briefly reviewed and their economics discussed.
W70-01948

COMBINATION OF HIGH-TEMPERATURE REACTOR WITH A CLOSED-CYCLE GAS TURBINE AND DESALINATION PLANT,
Gutehoffnungshuete Sterkrade A.G., Oberhausen (West Germany).
A. Ehret, H. Sonnenschein, and E. Bohm.
Preprint of Paper SM-113/6 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 13 p, 6 fig, 5 ref.

Identifiers: *Converter reactors, Process heat, *Turbine operation, Design, Dual-purpose plant, Dual-purpose plant economics, Multistage flash distillation, Reactor power cycle, Thermodynamic analysis, Turbines.

High-temperature reactors with closed-cycle gas turbines are suitable for combination with a desalination plant, as even in the course of normal operation waste heat is partly available at a sufficiently high temperature level to permit its use as process heat. To increase the water production in a dual-purpose plant several methods are available to esstentially increase the quantity of process heat in a closed gas turbine cycle. Which of these methods is most economic depends on several operating conditions. In some cases, the loss of electric power with increasing process heat supply is extremely low. Therefore, the costs of this additional heat are also extremely low and water production in such a plant is very economical. When combining a gas turbine circuit with a multistage flash evaporation plant, some special conditions of adaptation arise because the temperature of the working fluid is not constant during reheat extraction. From this a strong dependence between fresh-water output, maximum brine temperature, specific heat consumption in the desalination plant and process heat supply from the gas turbine plant results if the most economic design of dual-purpose plant is desired.
W70-01949

THE SODIUM-COOLED FAST BREEDER REACTOR AS A HEAT SOURCE FOR DESALINATION PLANTS,
Bechtel Corp., San Francisco, Calif.
R. A. Langley, and R. L. Clark.
Preprint of Paper SM-113/40 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968.
Identifiers: *Breeder reactors, *Economic evaluations, *Liquid-metal fast-breeder reactors, Coupling (Reactor-Desalting Plant), Design, Dual-purpose plant economics, Single-purpose plant economics, 0-500 MW (E) reactors, 500 plus MW (E) reactors.

Design evolution of the sodium-cooled fast breeder reactor as a dual-purpose or single-purpose energy source as it is affected by application to desalination is considered. Technical problems treated include selection of plant operating temperature, the steam cycle for the dual-purpose plant, ratio of electric power output to process steam, steam generator design, the need for a tertiary water loop between the liquid metal and the brine heaters, and containment design. These problems are discussed in terms of the 250-500 mw (e) plants in preliminary design in the U.S. and the 1000 mw (e) plants being studied as part of the USAEC Liquid Metal Fast Breeder Reactor Program. Evaluations of power and water costs for dual- and single-purpose plants as functions of plant size are made. Estimates of possible future power and water cost reductions as a result of design evolution and the development of a viable industry are also included.
W70-01950

PUMPED STORAGE - THE HANDMAIDEN OF NUCLEAR POWER,
Northeast Utilities Service Co., Hartford, Conn.
S. R. Knapp.
IEEE Spectrum 6 (4), p 46-52, 1968. 3 fig, 1 ref.
Identifiers: *Applications of nuclear energy, *Pumped storage, *Reviews, Base-load, Economic evaluation, Electrical System designs, Load factor, Northeast United States, Peaking power, Spinning reserve, Systems engineering.

The power companies of the New England States, where fossil fuel cost is high, have determined that low-variable-cost nuclear generation is desirable for this region. The construction of pumped-storage hydro plants, favored by the topography of the area, will offset the relatively high fixed costs of nuclear plants by maximizing the capacity-use factor of the nuclear facilities and thereby minimizing the total cost per unit of energy output. This combination provides efficient base load, economical peaking capacity, and effective spinning reserve, along with many recreational and other social benefits.
W70-01951

PRESSURIZED-WATER REACTORS FOR NATURAL AND ENRICHED URANIUM,
Siemens A. G., Erlangen (West Germany).
B. C. Drude, and F. H. Rohl.
Preprint of Paper SM-113/7 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 19 p, 6 fig, 6 ref.
Identifiers: *Dual-purpose plant, *Dual-purpose plant economics, *Nuclear energy sources, *Pressurized-water reactors, Energy sources, Heavy-water reactors, Turbine operation, Turbines.

Pressurized-water reactors are particularly well suited for high-capacity desalting plants. The heavy water and light water pwrs developed by Siemens Company represent two modifications of a common line. Reactors of either type with capacities up to 600 mw (e) in steel or concrete pressure vessels are available. Nuclear dual-purpose plants for electric power and process steam generation are rapidly gaining in importance. Technical and economic characteristics of high-powered units as required by the chemical industry have been studied for various flow schemes and ratings. Advantages and disadvantages of the back-pressure turbine cycle, offering the highest water-to-power ratio, are examined on the basis of realistic operating conditions. The economy of the plants may be improved by increased power production and adoption of suitable flow schemes. The advantages and disadvantages incurred by an extraction turbine or by a combination of back-pressure and condensing turbines are discussed. Specific investment and production costs of power and process steam are illustrated. For any particular case the two main parts of a dual-purpose plant may be chosen from among reactors of different design characteristics, and evaporators of different origin.
W70-01952

TECHNICAL AND ECONOMIC ASPECTS OF MEDIUM-POWER PLANTS FOR THE COMBINED PRODUCTION OF ELECTRICAL POWER AND DESALINATED WATER, USING VULCAN REACTORS AND LTV UNITS (IN FRENCH),
Societe Belge pour l'Industrie Nucleaire, Brussels; and Universal Desalting Corp., New York.
P. Maldague, C. Descamps, W. Debay, A. Paquet, and W. Bongard.
Preprint of Paper SM-113/17 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 19 p, 9 fig, 8 ref.
Identifiers: *Duel-purpose plant economics, *Vertical tube evaporators, Duel-purpose plant, Economic evaluations, Fixed charge rate, Nuclear energy sources, Pressurized-water reactors, Water costs estimate, 0-3000 MW (T) Reactors, 0-50 MGD Plant.

The technical and economic aspects of a dual-purpose plant are described. The plant couples a 280 MW (T) pressurized water reactor of the vulcan type with an LTV (Long Tube Vertical) desalination unit. The combination will produce 61 MW (E) and 24 MGD of product water. If power is assumed to be sold at 8 mills/kwh and a fixed charge rate of 11% is used, product water is estimated to cost 51.1 cents/1000 gal. If a fixed charge rate of 6% is assumed, the cost of water decreases to 40.1 cents/1000 gal.
W70-01953

ASPECTS IN DEVELOPING SEA WATER FLASH-DISTILLATION PLANT TO NUCLEAR-HEATED PLANT ON THE BASIS OF EXPERIENCE GAINED IN THE DESIGN, START-UP AND OPERATION OF SUCH INSTALLATIONS,
Atlas-Mak Maschinenbau G.m.b.H., Bremen (West Germany); and Fried-Krupp, Essen (West Germany). Zentralinstitut fuer Forschung und Entwicklung.
H. Laban, and W. Hohenhinnebusch.
Preprint of Paper SM-113/8 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 30 p, 12 fig, 4 ref.
Identifiers: *Corrosion control, *Dual-purpose plant economics, *Energy sources, *Operating experience, Corrosion, Distillation processes, Dual-purpose plant, Evaporators, Flash evaporation, Fossil fuels, Multistage flash distallation, Nuclear energy sources, Turbines, 0-50 MGD plant.

In 1965 the first major desalination plant of German design and with evaporators of German manufacture was built in Ceuta on the North African coast. The experience of construction, start-up, and several years of operation of the 1 MGD, 5000 KW (E) plant is described. Layout of the plant (flash evaporators arranged in two 24-stage blocks of 500,000 GPD each) and design of components and their resistance to corrosion are explained. Based on experience gained from this plant and numerous smaller installations, concepts for development of large-scale plants in combination with nuclear power stations are outlined. The possibility of combining a flash distillation plant with a gas turbine power station because of the cheap supply of waste heat is discussed. Cost aspects of such a dual-purpose installation are shown with reference to the various cycles on the basis of results obtained from different calculations.
W70-01954

HIGH-TEMPERATURE DESALINATION PLANTS FOR NUCLEAR POWER STATIONS,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
R. A. Tidball, and J. G. Gaydos.
Preprint of Paper SM-113/26 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 19 p, 11 fig, 5 ref.
Identifiers: *Multiple effect distillation, *Multistage flash distillation, *Water costs estimate, Wrightsville Beach Plant, Capitalized costs, Condensers, Energy costs, Fixed costs, Scale prevention, Scaling.

The maximum temperature to which brine can be heated in a multistage flash plant affects both capital costs and energy costs charged to the product water. It was demonstrated at the DSW east coast test facility that seawater can be treated with sulphuric acid and heated in a once-through plant to 300 deg F without scale formation in the condenser tubes. Scaling will occur at temperatures above 270 deg F when this seawater is recirculated with or without concentration. A combination of a once-through high-temperature effect with either a single-effect multistage flash plant (SEMS) or a multieffect multistage (MEMS) flash plant can be utilized to reduce both capital cost and energy charges. Purity of product water from most MSF plants varies from 5 to 100 PPM TDS. Purer water (down to 1 PPM) can be made at an increase in capital cost. Capital charges, energy charges and chemical charges are compared for 150 MGD plants using the SEMS, MEMS and the once-through topping plant in combination with both. The cost of water is presented based on these adaptations to the MWD study.
W70-01955

OPTIMUM BRINE HEATER STEAM TEMPERATURE ON MSF EVAPORATOR COUPLED WITH FOSSIL AND NUCLEAR FUELED POWER PLANTS,
GHH-Man Technik, Essen (West Germany).
B. Kunst.
Preprint of Paper SM-113/9 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 13 p, 16 fig, 5 ref.
Identifiers: *Brine heaters, *Dual-purpose plant economics, *Multistage flash distillation, *Pres-

surized-water reactors, Computerized design, Coupling (Reactor desalting plant), Economic evaluations, Energy sources, Single-purpose plant economics, Turbines.

The results of a computerized optimization study are presented in graphical form. Neither the computer program nor its flowsheet is given. Assumptions include 13% fixed charge rate, 7000 hours operation per year, fuel oil at 32 cents/MBTU, nuclear heat about 14.6 cents/MBTU, and terminal temperature difference of 4 deg C. Heat sources considered include a pressurized water reactor with a steam turbine, a high-temperature gas reactor with a gas turbine, and an oil-fired boiler with a steam turbine. Both single- and dual-purpose plants are considered. Optimization curves show the influence of the process steam temperature, the influence of the water-to-power ratio, the influence of capacity, and the water and power prices resulting from the optimizations. On the basis of the assumptions made, the high-temperature gas reactor is suitable for dual-purpose plants up to a water-to-power ratio of liters/KWH and the PWR system up to 140 liters/KWH depending upon capacity. In all cases a marked trend is noted towards process steam temperatures over 130 deg C.
W70-01956

HOT BRINE ENERGY STORE,
Aktiebolaget Atomenergi, Stockholm (Sweden).
P. H. Margen.
Energy Intern 6 (5), p 16-20, 1969. 8 fig, 1 ref.
Identifiers: *Peaking power, *Steam cycle, *Thermal-hydraulic design, *Water storage, Brine flow, Brine system designs, Dual-purpose plant economics, Pumped storage, Turbine operation.

One of the cheapest methods of energy storage is the storage of warm water at moderate pressures. In a combined electricity and desalting scheme, hot brine provides a convenient means of storing energy. Using a technology developed for district heating schemes, hot brine can be stored in the upper part of a storage accumulator and cooler brine in the lower part. When the brine accumulator is charged with heat, hot water is fed in at the top and cooler water is discharged at the bottom, so that the level subdividing the water regions at the two temperatures gradually falls. During discharge, the flow is reversed. The accumulator can be charged by the use of bled-off steam during off-peak electricity periods, thus reducing electricity generation at such times. It can be discharged at periods of peak electricity demand, allowing the turbine to operate without bled steam as a pure condensing turbine, producing a maximum amount of electrical power. Thus the electricity output can be varied over a certain range, while the nuclear steam generating unit and desalting unit operate continuously at constant full load. Preliminary calculations indicate that such operation would result in significant savings even though the large accumulator would require a large investment.
W70-01957

SOME FEATURES REQUIRED OF NUCLEAR REACTORS FOR DUAL-PURPOSE WATER/POWER PRODUCTION,
United Kingdom Atomic Energy Authority, Risley (England).
H. Kronberger.
Preprint of Paper, LAEA Symp Nucl Desalination, Madrid, Nov 18-22, 1968. 7 p.
Identifiers: *Dual-purpose plant economics, *Economic evaluations, *Load factor, Amortization criteria, Base-load, Dual-purpose plant, Peaking power, Thermodynamic analysis, Water costs estimate.

Of paramount importance in determining the economics of dual-purpose operation is maintenance of high load factor for the entire life of the complex. A new approach to reactor operation with a dual-purpose function is outlined. The background, technical features, and operating experience of UK-designed reactors (AGR, SGHWR, HTR, PFR) are outlined. Nuclear powered desalting plants might best be operated as water producers rather than power units. As water producers, they could take advantage of the 90% availabilities of British nuclear reactors. As an example, a dual-purpose 200 MW (E), 120 MGD SGHWR plant was examined. With 10% capital interest, a 25-year amortization period, and an average load factor of 75%, water costs were 55.4 cents/1000 gal with an electricity credit of 6.6 mills/kwhr. On the theory that such a plant could have a 90% availability, continuing operation at 90% load factor was considered even with the electricity part of the plant relegated to a position of lower importance, when it would normally be shut down. An extreme case considered is that of dumping the high-pressure steam, but keeping the desalting plant in operation. By doing this the water production is increased by 20% over 75% load factor operation with a total operating cost increase of only 5%. Water costs drop from 55.5 cents/1000 gal to 48.6.
W70-01959

THE MAIN UNCERTAINTIES IN THE ECONOMICS OF NUCLEAR ENERGY FOR THE PRODUCTION OF DEALINATED WATER,
Commissariat a l'Energie Atomique (France).
L. Thiriet, and P. Lievre.
Preprint of Paper SM-113/20 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 14 p, 2 fig, 3 ref.
Identifiers: *Dual-purpose plant economics, *Energy costs, *Nuclear energy sources, Cost allocation, Economic evaluations, Energy sources, Heat transfer coefficient, Interest, Nuclear desalination.

Scaled economies favor nuclear energy over conventional thermal energy. Thus when requirements for electrical power and heat, especially for desalination, are great enough, a favorable view may be taken of the use of nuclear energy, subject to certain assumptions. The validity of conclusions reached on the basis of these assumptions is discussed. The first part of the paper examines unknown factors associated with technical, economic and financial data (various transfer coefficients, service life of parts based on choice of materials, price trends, the shape of cost functions and interest rates). The second part discusses unknown factors associated with the optimization method used and the criterion of choice selected. It is shown that in most cases it is extremely difficult to reach a categorical conclusion as to whether or not nuclear energy is competitive for desalination, as many aspects of any given situation must be considered. (In French)
W70-01960

PROGRESS IN NUCLEAR POWER AND DESALINATION,
Southern California Edison Co., Los Angeles.
W. R. Gould.
In Nuclear Energy and Latin American Development, Nuclear Energy Laboratory, Univ of Calif, Los Angeles, p 49-55, 1969. Ed by C B Smith.
Identifiers: *Nuclear energy sources, Dual-purpose plant economics, Energy sources, Fossil fuels, Reviews.

A brief review of the present status of the construction of nuclear electric power plants in the United States and of the potential for dual-purpose power-desalting plants. The general conclusion is that the growth of nuclear power will be accelerated in proportion to the extent that the coal industry is unable to hold the line on prices, and more importantly, will depend on the ultimate development of fast breeder reactors. As the results of advancing technology and continued competition from the coal industry, we have long-range prospects of cheaper electrical energy and eventually of obtaining inexpensive fresh water using nuclear power.
W70-01961

THE ROVI REACTOR FOR DESALINATION OF SEA WATER - DESIGN AND INSTALLATION CRITERIA,
Montecatini Edison, Milan (Italy).
U. Cassinari, A. Grandellini, A. Vaudo, and G. Vacchelli.
Preprint of Paper SM-113/1 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 16 p, 4 fig, 3 ref.
Identifiers: *Coupling (Reactor-Desalting Plant), *Design criteria, Converter reactors, Plant safety analysis, Reactor design, Single-purpose plant, 0-3000 MW (T) Reactors, 0-50 MGD Plant.

Basic criteria are presented for design of a single-purpose low-power reactor for desalination of seawater, as well as criteria for optimum coupling of the reactor to the desalting plant. The ROVI reactor, cooled and moderated by hydrogenated terphenyl and designed for a power level of 100 MW (T) and a fresh water output of 13 MGD, was used for the study. Safety systems, fuel handling, ancillary cooling equipment, and possibility of producing on-the-spot power required by auxiliary plant facilities are discussed in detail, with particular attention to an analysis of reliability characteristics of the plant, the problem of reserve, and measures which might be necessary in this connection. A preliminary cost estimate is made with special reference to the size of the different facilities.
W70-01962

THE ECONOMIC DEVELOPMENT OF NUCLEAR DESALTING PLANTS IN WATER AND POWER SUPPLY SYSTEMS,
Hawaii Univ., Honolulu; and Calif. Univ., Los Angeles.
N. A. El-Ramly, and J. M. English.
Preprint of Paper SM-113/35 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 10 p, 5 ref.
Identifiers: *Dual-purpose plant economics, *Economic evaluations, Cost allocation, Design, Dual-purpose plant, Fixed charge rate, Interest, Product ratio, Systems engineering.

In addition to engineering factors influencing design characteristics of dual purpose plants, optimum size, product ratio, and other pertinent design variables are also dependent on economic and social influences, often peculiar to the geographic location under consideration. Factors and constraints affecting economics of system design are discussed. Relevant design variables are incorporated into a mathematical framework to show system interrelationship. It is indicated that optimum development depends on project timing in relation to long-range demand functions of water and power. Furthermore, the decision is sensitive to interest rates, demand growth patterns, and economics of scale. Optimum product ratio is determined by maximizing present worth of revenue minus cost streams. Effects of budget and other economic constraints as they pertain to the sequence of the total system development are considered. Merits of cost allocation policies and their effect on investment decisions are discussed. It is concluded that the proper method for allocating joint costs over the system economic life should be proportional to revenue steams. Also considered is economic implication of technological changes on rate of equipment obsolescence.
W70-01963

HEAT SUPPLY TO A DESALTING UNIT BY AN ORGANIC NUCLEAR SINGLE-PURPOSE REACTOR (IN ITALIAN),
Comitato Nazionale per l'Energia Nucleare, Rome (Italy); and Montecatini Edison, Milan (Italy).
L. Biondi, E. Crispino, R. Di Menza, F. Gazzabin, and E. Merli.
Preprint of Paper SM-113/5 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 7 p.
Identifiers: *Converter reactors, *Nuclear energy sources, *Single-purpose plant economics, Dual-purpose plant, Economic evaluations, Energy sources, Single-purpose plant.

Studies were performed for both single-purpose and dual-purpose plants on the problems of supplying heat from a nuclear plant to a desalting unit as a function of the fresh water capacity. In many areas where fresh water requirements are not high, it was concluded that single-purpose reactors producing only low-temperature heat may be more satisfactory than the large nuclear reactors of the present economic sizes. Of the different reactor types, organic reactors seem to obtain more advantage from the lowering of temperature and less disadvantage from the necessary reduction of size. The main rules which must be imposed on this reactor and the expected corresponding performance are taken into consideration.
W70-01964

OPTIMIZATION STUDY ON THE COUPLING OF A LOW TEMPERATURE ROVI REACTOR WITH A DESALTING PLANT,
Bari Univ. (Italy); and Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
G. Nebbia, R. Di Menza, and L. Pierazzi.
Preprint of Paper SM-113/4 Presented at IAEA Sump Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 7 p, 1 fig, 8 ref.
Identifiers: *Single-purpose plant, *Single-purpose plant economics, *Water costs estimate, Distillatica processes, Energy costs, Multistage flash distillation, Precipitation, Scale prevention, Vapor compression evaporation.

Results of an optimization study of effects, on both reactor and distillation plant, of raising present operating temperatures to those which may be used in the future indicate that minimum steam cost in water-only low-temperature nuclear reactors such as the organic-cooled and moderated ROVI could be obtained in the range of 150 to 200 deg C. Raising maximum brine temperature from 120 to 180 deg C should decrease water costs about 15%. For high-temperature operation, probably lower water costs are obtained using distillation processes such as the LTV and vapor compression instead of multistage flash, utilizing scale control measures such as addition of saturated solution of barium chloride to seawater for precipitation of sulphates. Conclusion is that optimum conditions for desalination in developing countries may be derived using nuclear water-only plants, rather than dual-purpose plants.
W70-01965

THE FUTURE ROLE OF BREEDER REACTORS IN UTILITY PLANNING,
Westinghouse Electric Corp., Pittsburgh, Pa.
J. K. Dillard, C. J. Baldwin, and N. H. Woodley.
IEEE SPECTRUM 7 (3), p 100-107, 1969. 10 fig, 12 ref.
Identifiers: *Economic evaluations, *Electrical system designs, *Systems engineering, Boiling-water reactors, Breeder reactors, Fossil fuels, Present worth, Pressurized-water reactors, Single-purpose plant.

Economics of breeder reactors in a power system of 14,000 MW (E) initial installed capacity was studied over a 20-year period starting in 1986. Four expansion patterns with different mixes of water reactors, breeder reactors, and fossil units were compared by present worth methods using digital computer simulation programs developed to study long-range economic problems of utilities. Levelized annual savings of 25 to 50 million dollars were estimated for expansion patterns which included high gain breeders. Sensitivity studies showed that the capital cost of breeders can be over 50% higher than water reactors and still be economic, that substantial savings still exist for growth rates as low as 5%, and that the value of plutonium as fuel in breeders compared with water reactors can vary over a wide range without destroying the advantage of breeders.
W70-01966

COMPARATIVE ECONOMICS OF LARGE FOSSIL-FUELED VERSUS NUCLEAR GENERATING STATIONS,
Niagara Mohawk Power Corp., Syracuse, N.Y.
M. H. Pratt.
Proc Amer Power Conf 27, p 610-15, 1965. 2 ref.
Identifiers: *Energy sources, *Fossil fuels, *Nuclear energy sources, Economic evaluations, Energy costs, Scheduling.

We have reached the point where we can confidently expect the new generation of larger nuclear plants currently under way to be, at the very least, very close to the comparative economic level of fossil-fueled plants. The most important and critical question at the moment is whether or not we can depend on the large nuclear plant to be ready to operate as an integral part of a total system at the time when system load requirements demand that its capacity be available. The actual final costs of any project taking several years to build will always be something different from the original estimates. Since now the estimated costs for nuclear and for fossil-fired plants now have considerable overlap, the decision for one or the other must be made on the basis of the ability of meeting a schedule required by load demands.
W70-01967

BRINE-HEATER LEAKAGE CONTROL PROBLEMS IN LARGE POWER DESALTING PLANTS,
W. H. Kelley.
Reactor Fuel-process Technol 12 (1), p 80-87, 1969. 4 fig, 5 tab, 7 ref.
Identifiers: *Brine heater leakage, *Brine heaters, *Hazards, *Nuclear stream supply system, Boiling-water reactors, Breeder reactors, Brine flow, Brine system designs, Converter reactors, Dual-purpose plant, Heavy-water/organic-cooled reactors, High temperature gas-cooled reactors, Israel, Liquid-metal fast-breeder reactors, Metropolitan water district, Multistage flash distillation, Radioactive contamination, Saline contamination, Vertical tube evaporators.

A study was made of brine-heater leakage problems in large nuclear dual-purpose power-desalting plants utilizing light-water reactors and multistage flash evaporators. Leakage of reactor condensate into the water plant was found to have an inconsequential effect on product-water purity. Leakage of brine into the reactor presents a considerable problem in demineralization or blowdown-and-makeup cost. The best presently available solution to the demineralization problem appears to be the use of a coated-filter ion-exchange unit, with immediate shutdown of a leaking brine heater. An installed spare brine heater was found to be economically attractive in preventing loss of power and product-water revenues. The use of vertical tube evaporators in place of or in conjunction with the conventional brine heaters would ensure against leakage of brine into the reactor plant. Several schemes utilizing vertical tube evaporators appear economically attractive.
W70-01968

THE ROLE OF NUCLEAR ENERGY IN DESALTING - A REVIEW OF THE U.S. ATOMIC ENERGY COMMISSION DESALTING DEVELOPMENT PROGRAM, PROBLEM AREAS, AND POTENTIAL,
Atomic Energy Commission, Washington, D.C.
W. A. Williams, J. C. Roberts, and R. D. McFarren.
Preprint of Paper SM-113/36 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 14 p, 23 ref.
Identifiers: *Dual-purpose plant, Coupling (Reactor-desalting plant), Dual-purpose plant economics, Economic evaluations, Nuclear desalination, Nuclear energy sources, Reviews, Water utilization.

The Atomic Energy Commission sponsors studies and research and development aimed at utilization of nuclear energy for desalting and other large-scale industrial processes. The origin and history of the AEC program, as well as its objectives and plans, and the considerations entering into the formulation and implementation of these plans. The economics and technical features of nuclear energy in the production of desalted water and other industrial processes are discussed as well as the technical, economic, administrative and other considerations encountered and the influences these considerations have on planning the development and demonstration of a new technology and its utilization. The roles of general and specific studies are outlined and their contribution to the definition of development plans and program goals are briefly explained.
W70-01969

3B. Water Yield Improvement

RUNOFF INDUCEMENT IN AN ARID REGION BY REMOVAL OF VEGETATION,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
N. H. Tadmor, and L. Shanan.
Soil Sci Soc Amer Proc, Vol 33, No 5, p 790-794, Sept-Oct 1969. 5 p, 3 fig, 2 tab, 19 ref.

Descriptors: *Watershed management, *Arid lands, *Vegetation effects, *Clear-cutting, *Water conservation, Water yield improvement, Runoff, Infiltration, Rainfall intensity, Soil moisture, Soil water movement, Soil physical properties, Rainfall-runoff relationships, Land management.
Identifiers: Negev Desert, Israel.

Watershed management was studied in an area 25 kilometers NW of Beersheba in the Negev Desert of Israel. The climate is Mediterranean, with hot dry summers and moderately cold winters. The annual runoff increased threefold from 7% to 21% after eradication of natural vegetation. Infiltration rates were increased by 40-50% by the vegetation cover. Both bare and covered areas required 2-4 mm/day of rainfall in order to produce runoff. Interception storage was 0.1-0.4 mm. (Carstea-USGS)
W70-01658

DEVELOPMENT PROBLEMS IN ARID ZONES,
For primary bibliographic entry see Field 06B.
W70-01805

WATER RESOURCES APPRAISAL OF THE WARM SPRINGS--LEMMON VALLEY AREA, WASHOE COUNTY, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
F. Eugene Rush, and Patrick A. Glancy.
Nevada Dept. of Conservation and Natural Resources, Water Resources-Reconnaisance Series Report 43, 1967. 70 p, 2 illus, 25 tab, 31 ref.

Descriptors: *Water resources, *Nevada, *Hydrologic aspects, *Geologic formations, *Water balance, Watersheds (Basins), Precipitation (Atmospheric), Inflow, Surface waters, Groundwater, Evapotranspiration, Irrigation, Water quality, Discharge (Water), Water supply, Hydrologic data, Transmissivity, Storage coefficient.

The area considered lies directly north of Reno in western Nevada, covering about 900 sq. mi. It is in the rain shadow of the Sierra Nevada and is arid, averaging less than 10 inches of precipitation per year. Because of its proximaty to Reno, further development of an urban-industrial nature is expected with ranching declining in importance. This report serves as a reconnaissance survey of the general hydrology of the area and may serve as a guide to further investigation as development requires. The alluvium of the valleys was found to be a maximum of at least 400 feet. To date little use has been made of groundwater-deposits, but tests for quality are suggested before beginning extensive drilling. At present all economically feasible

surface waters are developed and about 17,000 acre feet are imported annually from the Truckee River. Any additional water development will have to be from groundwater sources or importation. (Crouse-Arizona)
W70-01806

A BRIEF APPRAISAL OF THE WATER RESOURCES OF THE WALKER LAKE AREA, MINERAL, LYON, AND CHURCHILL COUNTIES, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
D. E. Everett, and F. Eugene Rush.
Nevada Department of Conservation and Natural Resources, Water Resources-Reconnaissance Series Report 40, 1967. 44 p, 10 tab, 5 fig, 17 ref.

Descriptors: *Water resources, *Nevada, *Hydrologic aspects, *Evaporation, *Water balance, Watersheds (Basins), Lakes, Precipitation (Atmospheric), Inflow, Groundwater, Surface waters, Evapotranspiration, Geologic formations, Water quality, Irrigation, Reservoir evaporation, Discharge (Water), Hydrologic data, Groundwater recharge, Recharge, Water storage.
Identifiers: *Walker Lake (Nev).

The region considered includes Walker Lake Valley and adjacent valleys in west-central Nevada. The area is extremely arid with precipitation generally averaging less than 5 inches per year. This report gives a general reconnaissance survey of the hydrology of the area and may serve as a guide to further investigations that may prove desirable. Inflow to the area is estimated at 169,000 acre-feet per year while total discharge is about 265,000 acre-feet--largely evaporation from Walker Lake and Weber Reservoir. Walker Lake has been depleted at an average annual rate of about 100,000 acre-feet since 1908. Groundwater levels in the area have declined slowly because of lowering lake stage. The only significant groundwater development has been in the Hawthorne area for municipal and Naval Ammunition Depot use. Most of the groundwater is suitable for agricultural and municipal use. However, any future well development would have to be undertaken with the steadily declining ground water levels in view. (Crouse-Arizona)
W70-01807

PAPAGO FLOODWATER PASTURES SHOW PROMISE,
Arizona Univ., Tucson; and Bureau of Indian Affairs, Papago Indian Reservation, Ariz.
J. R. Simpson, R. A. Young, P. R. Ogden, and C. W. Whitfield.
Progressive Agriculture in Arizona, Vol 21, No 2, Mar-Apr 1969, 18-19. 2 photos, 1 tab.

Descriptors: *Range management, *Arizona, *Economic feasibility, *Costs, *Flood irrigation, Water yield improvement, Grazing, Brush control, Range grasses, Arid lands, Carrying capacity, Indian reservations, Pasture management, Irrigation practices, Runoff, Storm runoff.
Identifiers: *Papago Indian Reservation (Ariz).

Flood runoff from summer convective storms was used to irrigate supplemental perennial grass pasture on the arid Papago Indian Reservation west of Tucson, Arizona. Since the forage produced was of considerable value in providing feed during the hot, dry seasons, a cost analysis was made. It was found that where local flood runoff could be used for irrigation, the clearing and reseeding of range lands to blue panicgrass and Lehman lovegrass could be economically attractive. When amortized at 8% for 50 years, the cost was $2.14 per animal unit month. (Crouse-Arizona)
W70-01813

THE 'EL NINO' PHENOMENON AND RAINFALL IN PERU AND ECUADOR,
Texas A and M Univ., College Station. Dept. of Meteorology; and Texas A and M Research Foundation, College Station.
L. Glenn Cobb.
In Walter K. Henry et al., Research on Tropical Rainfall Patterns and Associated Mesoscale Systems. US Army Electronics Command, Ft. Monmouth, NJ Technical Report ECOM- 02313-S2, 1967, p 87-103. 17 p, 2 tab, 4 fig, 26 ref.

Descriptors: *Air circulation, *Arid lands, *Meteorology, *Ocean currents, *Precipitation (Atmospheric), Ocean circulation, California, Rainfall, Pacific Ocean, Temperature, Surface waters, Thunderstorms, Meteorological data.
Identifiers: *'El Nino' Phenomenon, *Peru, *Ecuador, Chile, Australia, Southwest Africa.

The cold Peru or Humboldt Current along the west coast of South America causes colder surface water temperatures along the coast than along the open ocean. The deserts of Chile and Peru are a result. At intervals of several years a general weakening of atmospheric circulation in the South Pacific results in a weakening of upwelling and significantly higher surface water temperatures known as the 'El Nino' phenomenon. The study reported here shows a high correlation between increased surface water temperatures and greatly increased summer rainfall on the adjacent coastal plain. Areas that normally have little or no rainfall will have at least several large thunderstorms during a season with the 'El Nino' phenomenon. It is suggested that with improved knowledge of atmospheric circulation it should be possible to predict these occurrences. Similar phenomena occur off California, southwest Africa, and western Australia. (Crouse-Arizona)
W70-01816

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
Hebrew Univ., Jerusalem (Israel). Dept. of Agriculture; and National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
D. Hillel, and E. Rawitz.
9th International Congress of Soil Science, Adelaide, Australia, 1968, Transactions, Vol 1, p 303-311. 9 p, 4 tab, 2 fig, 3 ref.

Descriptors: *Arid lands, *Water harvesting, *Surface runoff, *Soil treatment, *Agriculture, Soil dispersants, Soil aggregates, Soil compaction, Soil erosion, Soil structure, Semiarid climates, Runoff, Soil stabilization, Erosion, Infiltration, Rainfall-runoff relationships.
Identifiers: *Israel, *Negev Plains.

In arid or semiarid lands where rainfall is insufficient but soil is otherwise arable, increase of surface runoff from sloping lands to the planted area would be of great importance. Field trials conducted in the Negev Plains included such treatments as compaction, salting, fuel oil spray, cultivation, and aggregation with krilium. Stable aggregate formation reduced runoff to practically zero, whereas crust formation with fuel oil induced runoff in excess of 80% of seasonal rainfall. Excessive erosion occurred in salt-treated and cultivated plots. Erosion from the fuel oil treatment was low. This promising treatment would also be useful for water harvesting applications. (Crouse-Arizona)
W70-01820

THE ISRAELI ARTIFICIAL RAINFALL STIMULATION EXPERIMENT. STATISTICAL EVALUATION FOR THE PERIOD 1961-65,
Hebrew Univ., Jerusalem (Israel).
K. R. Gabriel.
Berkeley Symposium on Mathematical Statistics and Probability. 5th, Berkeley California, 1965-1966, Proceedings, Vol 5, 1967, p 91-113. 23 p, 12 tab, 3 fig, 28 ref.

Descriptors: *Cloud seeding, *Statistical methods, *Silver iodide, *Arid lands, Weather modification, Design criteria, Aircraft, Data collections, Precipitation (Atmospheric), Analytical techniques.
Identifiers: *Israel, *Experimental design, Randomized crossover design.

This paper presents a statistical evaluation of effects on precipitation of cloud seeding experiments using silver iodide in Israel. A randomized crossover design was used. Problems of analysis and advantages of design are discussed. Average excess of precipitation on seeded days was about 15% - significant at the 5% level. The secondary objective of identifying meteorological conditions favorable or unfavorable to successful stimulation was not achieved at the time of this report. Apparently, effects of seeding did not persist beyond the day of seeding. (Crouse-Arizona)
W70-01821

THE NILE IN THE SUDAN,
Khartoum Univ. (Sudan).
L. Berry, and A. J. Whiteman.
Geographical Journal Vol 134, PT 1, 1968, p 1-37. 6 tab, 19 fig, 52 ref.

Descriptors: *Geomorphology, *Geographical regions, *River systems, *Arid climates, *Stratigraphy, Geologic investigations, Evaporation, Geologic formations, Hydrogeology, Geologic mapping.
Identifiers: *Physical geography, *Geography, *Nile, Sudan, Egypt, Ethiopia, Africa.

Many scientists have studied the Nile--a main source of water for the agriculture of arid Sudan and Egypt. However, its physical history is little known, since most of the work has been concentrated on Egyption stratigraphy and denudation chronology. In this study the authors recognize four major sections, each of which is considered separately: the Blue Nile Basin, the Victoria and Albert Nile, the White Nile or Bahr el Abiad Basin, and the Main Nile Basin. The authors have conducted extensive field work and their findings, together with a critical review of pertinent literature, lead to the conclusion that sections of the Nile had their origins in Late Cretaceous times or earlier. The present Nile, then, is a complex formed by chance linkage of several basins with different structural and erosional histories. It is hypothesized that in drier times such as occurred in the head waters of the Blue Nile during periods of the Pleistocene, the waters would not have reached the White Nile or the Main Nile, but would instead have spread out and been lost in the arid Sudan. Tentative denudation and depositional chronologies are presented. (Crouse-Arizona)
W70-01828

WATER USE AND MANAGEMENT OF PONDEROSA PINE IN NORTHERN ARIZONA,
Arizona Univ., Tucson. Dept. of Watershed Management.
W. L. Russel and J. L. Thames.
Progressive Agriculture in Arizona, Vol 20, No 5, Sep-Oct 1968, p 10-11. 2 fig.

Descriptors: *Watershed management, *Arid lands, *Soil-water-plant relationships, *Water yield improvement, *Forest management, Arizona, Clear-cutting, Evapotranspiration, Water loss, Soil moisture, Pine trees, Ponderosa pine trees, Moisture content.

Principle sources of water for arid-land agricultural and urban valleys of Arizona are the high elevation ponderosa pine forests. Sound management of these watersheds requires knowledge of the water use and the potential for improving water yield of this species. Three study sites were used: a natural second growth pine plot with about 150 square feet basal area, one plot thinned to 40% of the original volume of pine growth, and a third clearcut with remaining vegetation killed chemically. There was

an approx. 80% difference in water loss between natural and clear-cut sites. The difference between natural and thinned plots was only about 20% of the difference shown on the clear cut. Water savings on the thinned area were not proportionate to the volume of timber removed. Results indicate that clear-cutting practices similar to West Coast block cuts would be advantageous from the standpoint of water yield. (Crouse-Arizona)
W70-01829

REPORT ON EVAPORATION CONTROL ON STOCK TANKS, RESERVOIRS,
Arizona Univ., Tucson. Water Resources Center.
C. Brent Cluff.
Progressive Agriculture in Arizona, Vol 19, No 2, p 4-5, Mar-Apr 1967. 4 fig.

Descriptors: *Evaporation control, *Monomolecular films, *Reservoir evaporation, Arizona, Water costs, Costs, Application equipment, Seepage.
Identifiers: *Evaporation control devices, *Rafts, Dispensers.

Methods for applying monolayer alcohols to reduce evaporation losses from stock ponds and small reservoirs in Arizona were tested. The most efficient was a wind operated dispenser. Even with this machine, costs per thousand gallons saved were over $3.50 for tanks up to one acre in size. The cost did not drop below $1.00 per thousand gallons unless the reservoir surface exceeded 15 acres. Several types of floating plastic rafts were found to be very effective in controlling evaporation losses. The most efficient had costs per unit lower than most domestic water supplies. (Crouse-Arizona)
W70-01834

RESULT OF CLOUD SEEDING EXPERIMENT AT DELHI AS ASSESSED BY RADAR,
Inst. of Tropical Meteorology, Poona (India).
R. N. Chaterjee, K. R. Biswas, and Bh. V. Ramana Murty.
Indian J Meteorol and Geophys, Vol 20, No 1, p 11-16, Jan 1969. 6 p, 6 tab, 6 ref.

Descriptors: *Cloud seeding, *Radar, Microwaves, Rain, Monsoons, Precipitation (Atmospheric), Seasonal, Instrumentation, Analytical techniques, Rain gages.
Identifiers: *India.

The result of cloud-seeding experiments conducted in the Delhi, India, area from 1961 to 1966 were examined by using a high-power microwave radar measuring areal echo coverage and echo height of rain cells. The trend of the result is positive on the basis of areal echo coverage, and negative on the basis of mean echo heights. However, as the assessment made is only qualitative in nature, it does not confirm that the rain over the area is increased by seeding by the specific amount indicated by the analysis. (Gabriel-USGS)
W70-01876

WEATHER MODIFICATION: LAW AND ADMINISTRATION,
Colorado Univ., Boulder.
James N. Corbridge, Jr., and Raphael J. Moses.
Natural Resources Journal, Vol 8, No 2, p 207-235, Apr 1968. abt 150 ref.

Descriptors: *Weather modification, *Legal aspects, *Administration, Legislation, History, Administrative agencies, United Nations.
Identifiers: Supra-national administrative system, Powers and responsibilities.

The article evaluates the present scientific and legal situation of weather control. Section I summarizes the historical development of weather modification. Sections II, III and IV discuss the development of private law doctrines and existing and proposed legislation. Existing law has evolved around property rights and remedies for the invasion of these rights. Section V demonstrates the need for a different legal approach. The first need is for establishment of a central administrative agency to supervise all weather modification activity in each country. This agency should register and license operators, impose controls on operation, require assurance of financial responsibility in the event of damage, and collect and disseminate information. Section VI analyzes possible legal and administrative solutions. Models include the Atomic Energy Act, the U.N. Committee on Peaceful Uses of Outer Space, the European Space Research Organization (ESRO/CERS) and the European Organization for the Development and Construction of Space Vehicle Launcers (ELDO/CECLES). The United Stations is proposed as a locus for an international, supra-national system of licensing, inspection and reporting. (Gossen-Chicago)
W70-02028

3C. Use of Water of Impaired Quality

PRELIMINARY STUDY OF A DESALTING POWER INDUSTRIAL COMPLEX IN ISRAEL,
Israel Atomic Energy Commission, Tel Aviv; and Water Planning for Israel Ltd., Tel Aviv.
J. Adar, D. Caplin, G. Frank, and D. Tavory.
Preprint of Paper SM-113/10 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 30 p, 4 fig, 4 ref.
Identifiers: *By-product economics, *By-product manufacturing processes, *Electrochemonuclear systems, *Israel, Dual-purpose plant, Economic evaluations, Energy costs, Feasibility study, Industries, Nuclear energy sources, 3000 plus MW (T) reactors, 51-250 MGD plant.

A dual-purpose plant will be needed in Israel in the middle 1970s to add some 300 MW (E) and 150 mgd to the national electricity and water grids. This study examines the profitability of combining with the dual-purpose plant an industrial complex fed by the low-cost incremental power (either electricity or low-pressure steam) of the larger reactor that would be required. The study includes two parts. (1) Incremental costs of power are estimated. Use of us light-water reactors of 2370 and 3300 mwt (or combination of both) is considered. Depending on size and number of reactors and on different steam cycles chosen, amounts of incremental electricity and low-pressure steam available for industrial complex vary between 118 to 930 mwe and 0 to 3.95 million lb/hr. Depending also on the different fixed charge rates considered, costs vary between 1.82-5.5 mill/kwh and 0-76 cents/mbtu. (2) A preliminary survey of process industries (chemical and metallurgical) is made. Processes were selected according to market possibilities for products or derivatives, preference for utilization of local raw material and/or intermediaries, the advantage of processing in Israel certain minerals or mineral concentrates. Effects of basic industries considered on the overall economic development of Israel is reviewed.
W70-01732

DUAL-PURPOSE NUCLEAR POWER PLANT WITH INCORPORATED PRODUCTION OF SALT,
Tokyo Inst. of Tech., (Japan); and Asahi Chemical Industry Co. Ltd., Tokoyo (Japan).
H. Kakihana, and Y. Tsunoda.
Preprint of paper SM-113/11 presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 12 p, 10 fig.
Identifiers: *By-product economics, *By-product manufacturing processes, Chemical by-product, *Dual-purpose plant economics, Electrochemonuclear systems, Japan, Membrane processes, Multipurpose plant, Multipurpose plant economics, Scale prevention.

Since Japan imports all its industrial salt, it is desirable to salvage brine from evaporation, concentrating it by electrodialysis and evaporating it. One overall plan for such utilization of seawater is discussed. This process is characterized by the use of a special type of anion and cation exchange membranes in the electrodialysis, incorporating it into the evaporation step of a dual-purpose nuclear power plant. Scaling in the heat exchanger of the evaporator is greatly reduced, making the distillation operation easier and less expensive. In addition to production of electric power, fresh water and industrial salt, if the plant is large enough five other products may be manufactured - magnesium hydroxide, chlorine, glaubers salt, potassium chloride, gypsum, and hydrogen.
W70-01733

ECONOMIC CONSIDERATIONS OF NUCLEAR ENERGY CENTRES FOR THE PRODUCTION OF CHEMICALS FROM SEA SALT IN DEVELOPING COUNTRIES,
United Nations Industrial Development Organization, Vienna (Austria).
P. M. Terlizzi.
Preprint of Paper SM-113/13 presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 20 p, 5 fig, 2 ref.
Identifiers: *Agro-industrial complexes, *Chemical production, *Nuclear energy sources, By-product economics, By-product manufacturing processes, Economic evaluations, Electrochemonuclear systems, Energy sources, Feasibility study.

The economics of production of chemicals from sea salt in developing countries utilizing nuclear fuel system is reviewed. The use of selected nuclear systems versus solar evaporation techniques, freezing, and geothermal resources as well as the level of nuclear fuel system sophistication which could possible be utilized to economic advantage are discussed in terms of technology, investment, personnel requirements and marketing economics of chemicals produced.
W70-01734

APPLICATION OF THE HTGR-CCGT SYSTEM IN DUAL-PURPOSE NUCLEAR POWER PLANTS,
Hoterv, Budapest (Hungary).
J. Halzl, Z. Szabo, L. Szucs, and M. Torma.
Preprint of Paper SM-113/14 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 26 p, 15 fig, 4 ref.
Identifiers: *Gas turbines, *High-temperature gas-cooled reactors, Aluminum, Dual-purpose plant, Electrochemonuclear systems, Energy sources, Flowsheets, Heat balance, Heat exchangers, Heat recovery, Heat transfer, Nuclear energy sources, Thermodynamics, Turbines.

The use of the high-temperature gas-cooled reactor closed-cycle gas-turbine (HTGR-CCGT) for the simultaneous supply of heat and electricity and its application to alumina-aluminum producing industrial complexes and to water desalination is explored. The influence of heat exchanger costs on the overall economy of the CCGT system is emphasized. In order to reduce costs it is suggested that mercury in specially designed equipment be used as heat-transmittent medium. Solutions of several heat exchanger design problems are presented, with several diagrams for the dimensioning of high-efficiency plate fins, taking into account both the temperature variation of the temperature field, existing in the gas flow, and the heat conduction of the fin, also in the direction of the flow.
W70-01735

APPLICATION OF NUCLEAR REACTORS IN THE ALUMINA AND ALUMINUM INDUSTRY,
Hoterv, Budapest (Hungary).
J. Halzl, G. Sigmond, Z. Szabo, and M. Torma.
Preprint of Paper SM-113/15 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 15 p, 5 fig, 2 ref.
Identifiers: *Aluminum, *Economic evaluations, *Multipurpose plant, *Multipurpose plant economics, Chemical production, Elec-

trochemonuclear systems, Energy sources, Nuclear energy sources.

The potentialities of dual-purpose nuclear power plants in the alumina-aluminum industry are analyzed. Results are summarized of economy calculations both for the back-pressure power plant supplying heat and electricity for an alumina plant only and for the power plant supplying both the alumina plant and the aluminum shelter. The calculations were done in terms of the capacity of the alumina plant using the following parameters - (A) rate of amortization, (B) power credit, (C) cost of fossil fuel, and (D) temperature level of heat demand. Nuclear energy supply variants were based on the PWR reactor but for big alumina plants and for the combined supply of the alumina plant and the aluminum smelter, the application of AGR reactors was also investigated.
W70-01736

POSITIONS OF COMPETITION BETWEEN WATER OBTAINED BY DESALINATION AND NATURAL RESOURCES,
Commissariat a L'Energie Atomique, France.
J. Gaussens.
Preprint of Paper SM-113/19 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 12 p, 5 fig.
Identifiers: *Economic conditions, *Water utilization, Base-load, Economic evaluations, Peaking power, Water sources.

The planning of a seawater desalting plant in a given region involves careful consideration of local fresh water supply and demand. In many cases, a thorough study of the natural resources available reveals that desalination is not needed. In other cases natural resources and desalination systems can be complementary, with the one contributing to the peak demand and the other to the base load. This analysis makes it possible to classify the main consumer regions according to certain economic criteria which define their suitability for the use of desalination processes. (In French)
W70-01737

CONTRIBUTION TO THE ECONOMIC STUDY OF MULTIPLE-PURPOSE PLANTS FOR POWER GENERATION, SEA WATER DESALINATION AND INDUSTRIAL CHEMICAL PRODUCTION,
Groupement d'Etudes de Dessalement Des Eaux Salees, Paris (France).
R. Douvry, and P. E. Dorges.
Preprint of Paper 113/22 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 31 p.
Identifiers: *Electrochemonuclear systems, *Multipurpose plant, Chemical by-products, Chemical production, Dual-purpose plant, Dual-purpose plant economics, Economic evaluations, Fertilizer, Multipurpose plant economics.

Optimization of dual-purpose plants results in production of considerably more electricity than can be used in many countries which can utilize the fresh water production. Therefore, association of these units with large power-consuming industries becomes potentially profitable, and it is possible to plan multiple purpose plants producing electricity, fresh water, industrial chemicals, fertilizers and electro-metallurgical goods. In industrialized countries output from these plants can be marketed in the area produced, but in other countries the output must be sold for export, either as semi-finished products or as processed raw material. This study considers the various products which can be processed in triple-purpose plants, both in the general case and at particular geographical locations. (In French)
W70-01738

ENERGY-INTENSIVE AND HEAT-INTENSIVE PROCESSES FOR A NUCLEAR ENERGY CENTER,
Oak Ridge National Lab., Tenn.
J. M. Holmes.
In abundant Nuclear Energy, Proc Symp Gatlinburg, Tenn, Aug 1968. p 29-43, 1 fig, 6 tab, 24 ref. AEC Symp Ser 14 (CONF-680810) 1969.
Identifiers: *Agro-industrial complexes, *By-product manufacturing processes, *Nuclear energy sources, *Process heat, By-product economics, Chemical by-products, Chemical production, Electrochemonuclear systems, Energy costs, Energy sources, Fertilizer, Multipurpose plant.

Chemical and metallurgical industries are large energy consumers with increasing power demands and significant sensitivities to changes in electricity prices. The major categories considered for installation at nuclear energy centers include (1) balanced fertilizers, (2) metals, such as aluminum, iron, steel, and magnesium, (3) plastics, and (4) brine chemicals. Other energy-intensive systems that may show promise include waste-water treatment, electric railways, high-temperature process heating, urban space heating, and several recently developed electroorganic processes. For economic utilization of the power from a 1000 MW (E) nuclear reactor, a number of the proposed systems would have to be combined into a complex.
W70-01739

A BLEACHED STRAW PULP MILL FOR AN AGRO-INDUSTRIAL COMPLEX,
Parsons and Whittemore, Inc., New York.
J. N. McGovern.
IN Abundant Nuclear Energy, Proc Symp Gatlinburg, Tenn, Aug 1968. p 205-18, 2 fig, 6 tab, 8 ref. AEC Symp Ser 14 (CONF-680810) 1969.
Identifiers: *Agro-industrial complexes, *By-product manufacturing processes, *Nuclear energy sources, *Process heat, By-product economics, Energy costs, Energy sources, Multipurpose plant.

The size and type of a hypothetical pulp mill to be part of an agro-industrial complex and to use residual wheat straw are developed. The choice of a pulping process is discussed, and process and material flows for the resultant 500 ton/day bleached sulfate pulp mill are shown. The mill would use power, heat, and water from the complex. The properties of short-fiber straw are compared with those of wood fibers, and a promising market for the straw pulp in the manufacture of book paper in developing countries is indicated. Plant-site factors are mentioned briefly. Capital requirements for the hypothetical mill are estimated at $60 to $65 million. It is considered that the hypothetical mill could be practical.
W70-01740

MARINE CHEMICAL RECOVERY,
Oak Ridge National Lab., Tenn.
W. C. Yee.
IN Abundant Nuclear Energy, Proc Symp Gatlinburg, Tenn, Aug 1968. p 249-68, 10 fig, 12 ref. AEC Symp Ser 14 (CONF-680810) 1969.
Identifiers: *Agro-industrial complexes, *By-product manufacturing processes, *Nuclear energy sources, *Process heat, *Solar energy sources, Chemical by-products, Chemical production, Multipurpose plant.

An economic analysis is made of several possible salt complexes that recover chemicals from the brine discharge of a nuclear desalination plant producing 100 MGD of fresh water with a seawater concentration factor of 2. Primary product recovery involves using solar energy at an arid desert site to recover sequentially gypsum, salt, potash, and magnesium chloride by fractional crystallization. Secondary product production involves using electrical and steam energy from the desalination plant to obtain cement and sulfuric acid, caustic soda and chlorine, and magnesium metal. Caustic soda and chlorine (as hydrochloric acid) can be used to remove bicarbonate ions from seawater prior to fresh-water production. Land requirements for solar evaporation are reduced by the availability of evaporator effluent as a starting material. The utilization of 3% of the brine discharge (2 x seawater) would consume 400 MW (E) of electric power, would require a capital investment of $84 million, would generate an income of $40 million, and would have a break-even power cost of 5.5 mills/kwhr at a 10% cost of money. Seawater treatment by the caustic-hydrochloric acid method would compete with the conventional sulfuric acid method of treatment at a power cost of 4 mills/kwhr when sulfur costs $50/ton.
W70-01742

THE CHEMICAL UTILIZATION OF WATER-DESALINATION RESIDUES,
United Nations Industrial Development Organization, Vienna (Austria).
N. K. Grigoriev.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 65-74. 3 tab, 8 ref. (IAEA STI/PUB/210, 1969). Was Paper PL-264/2 at meeting.
Identifiers: *By-product economics, *Chemical by-products, By-product manufacturing processes, Chemical production, Economic evaluations.

Seawater contains many salts, and this paper mentions several publications describing the industrial potentialities. A model plant is then described for recovering chemicals from water-desalination residues. The suggestion is that seawater be chlorinated, filtered and frozen. The residue after separation of ice is treated with gypsum and cooled to a lower temperature to yield sodium chloride, potash and bromine. Subsidiary processing would yield caustic soda, chlorine, hydrogen, lime, magnesia, hydrochloric acid and other products. Costs are quoted and the value of the fresh water is estimated at 10 cents/1000 gal.
W70-01743

THE DESIGN OF WATER SUPPLY SYSTEMS BASED ON DESALINATION.
United Nations, New York.

ST/ECA/106, 1968. 64 p, 6 tab, 8 fig, 3 ref.
Identifiers: *Economic evaluations, *Feasibility study, *Water utilization, Capitalized costs, Distillation processes, Fixed charge rate, Interest, Investment (Fixed), Operating costs, Plant availability, Water costs estimate, Water sources, Water storage.

Since the design of a water supply involving desalination is strongly influenced by local conditions, it is recommended that cases be analyzed individually. The major system variables include the number of units and the total capacity of desalination to be installed and amount and type of storage to be installed. Knowledge is needed of (1) demand characteristics - existing and expected future levels, including details of short-term and seasonal variations, (2) the types and capacities of storage which can be made available locally and the costs of these facilities, and (3) the likelihood and duration of periods of downtime to which any desalination plant configuration may be subject. Three types of situations have been considered (1) desalination as the sole source of water supply, (2) desalination in conjunction with ground-water supplies, and (3) desalination in conjunction with surface-water supplies. A narrative discussion of the above factors is given and an appendix covers sample calculations for the various items considered.
W70-01744

POWER - IS IT THE KEY TO FOOD SUFFICIENCY IN INDIA,
California Univ., Davis.
P. R. Stout.
Bull At Sci 24 (9), 1968, p 26-28.
Identifiers: *Agriculture, *Fertilizer, *Land utilization, *Water utilization, Agro-industrial complexes, Energy sources, India, Nuclear energy sources.

Food sufficiency can be achieved and maintained in India if adequate sources of low-cost energy can be established quickly. But power must be made

available to pump water out of the ground for irrigation and to manufacture nitrogen fertilizer. These energy-consuming farm inputs would enable Indian farmers on the Indo-Gangetic plan to grow high-yield cereal grains during the winter dry season, when good lands now lie idle. Nuclear energy appears to be the quickest and cheapest means of providing this electrical power. Power levels would have to approach the energy inputs required by intensive cultivation practices in the worlds food-sufficient, industrialized nations. One reactor, providing power for irrigation and for the manufacture of 352,000 tons of fixed nitrogen, makes it possible to grow an additional 12.3 million tons of food grain. Two such units would be sufficient to fill Indias estimated 1973 gap in food grain of 23 million tons. A third unit, added by 1978, a fourth in 1983, and a fifth in 1988 would be required to keep the gap closed. A sixth unit by 1990 would fill the minimum shortage, predicted for that time, of 72 million tons.
W70-01745

ECONOMIC CONSIDERATIONS IN INTRODUCING DESALTED WATER INTO AGRICULTURE,
Water Commission of Israel, Tel Aviv.
E. Dlayahu.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 93-104. 9 ref. (IAEA STI/PUB/210, 1969). Was Paper PL-264/3 at meeting.
Identifiers: *Agriculture, *Economic evaluations, *Water utilization, Ground rules, Israel, Land utilization.

Technological advances of recent decades have made large-scale desalination technically possible. The remaining obstacle to such development is economic. The testing ground of economic feasibility lies in agriculture, the major and marginal consumer of water. Criteria are discussed here for determining economic feasibility of using desalted water in agriculture, drawing on the experience of Israel for illustration. Topics dealt with include water costs, prices and subsidies, methods of estimating the value of irrigation water, economic and agro-technical problems in the large-scale use of desalted water, and quantity and quality as factors determining the value of desalted water. The following conclusions are drawn - with current techniques, a gap still exists between costs and benefits. Large plants of the future offer prospects of internal economics, but must face external diseconomics of scale. Desalination offers the best prospects, economically, in arid zones requiring perennial irrigation water. Greater economic benefits may be expected from water quality than from quantity. Best prospect for development in the near future lies in continued research and effective exchange of information, rather than in artificial stimulation by direct subsidization.
W70-01747

SOME CONSIDERATIONS OF THE VALUE TO AGRICULTURE OF HIGH-QUALITY WATER FROM NUCLEAR DESALINATION,
Food and Agriculture Organization of the United Nations, Rome (Italy).
H. G. F. Kreutzer.
In Proc Panel, Value to Agriculture of High-quality water from Nuclear Desalination, Vienna, 1967, p 77-92. 8 tab, 8 ref. (IAEA STI/PUB/210, 1969). Was Paper PL-264/14 at meeting.
Identifiers: *Agronomy, *Water costs estimate, *Water utilization, Agriculture, Land utilization.

The cost of water from nuclear desalination plants is still too high in comparison with what farmers pay at present for irrigation water from conventional sources. For the time being there seems to remain a very wide field of research work concerning the exact determination of water requirements under various conditions, the breeding and selection of salt-tolerant plants, which guarantee yields that are almost as high as those obtained under normal conditions, the improvement and application of the most advanced irrigation techniques, and the control of evaporation and seepage losses surface-water storage. There seems to exist only a few possibilities of making use of the power produced in the context of the desalination process, as agriculture itself can only undertake a very small part of it. To make the desert bloom, irrigation needs tremendous quantities of water at a low cost at the irrigation site. In view of the rapid development in this fairly new field of experimentation, it is hoped that further experiments, or even a breakthrough, may allow the food and agriculture organization to recommend its widespread application to agriculture.
W70-01748

THE ROLE OF NUCLEAR ENERGY IN DESALTING WATER FOR AGRICULTURE,
Oak Ridge National Lab., Tenn.
R. P. Hammond.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 9-22. 4 tab, 4 fig. (IAEA STI/PUB/210, 1969). Was Paper PL-264/18 at meeting.
Identifiers: *Agriculture, *Economic evaluations, *Nuclear desalination, AEC sponsored, Energy sources, Heat transfer improvements, Land utilization, Nuclear energy sources, Water costs estimate, Water utilization.

The great importance of energy in the productivity of agriculture has only recently been recognized. Since the easily cultivable land in the world is fully utilized, the needs for more food will have to be met by increasing the output from present acreage and by bringing water to land which is now too dry for farming. Both methods require energy, in the form of fertilizer, cultivating power, insecticides and herbicides, pumps, and desalting of seawater. In many parts of the earth, nuclear energy is already the cheapest available form of large energy source, and the advent of the breeder reactor will lower cost still more. A look at the fuel resources available for breeder reactors shows that they are as inexhaustible as the water of the ocean. Since agriculture will need very large amounts of energy, especially for desalting seawater, the very size of the installations will help to reduce the unit cost of energy. Besides cheap energy, water production requires low-cost evaporators, and important breakthroughs have been made in the technology of evaporator design. One of these is the use of double-fluted vertical tubes, which transfer heat more cheaply than conventional tubes. Other improvements are concerned with the use of concrete construction and scale control.
W70-01749

THE NUCLEAR-POWERED AGRO-INDUSTRIAL COMPLEX,
Oak Ridge National Lab., Tenn.
R. P. Hammond.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 31-64. 15 tab, 10 fig. (IAEA STI/PUB/210, 1969). Was Paper PL-264/19 at meeting.
Identifiers: *Agro-industrial complexes, *Economic evaluations, AEC sponsored, Agriculture, Capitalized costs, Chemical production, Fertilizer, Land utilization, Nuclear energy sources, Water costs estimate, Water utilization.

A study team of expert consultants and scientists of the Oak Ridge National Laboratory is attempting to determine, technically and economically, what can be accomplished by using low-cost nuclear energy under optimum conditions for desalting seawater and for providing industrial power. An agro-industrial complex centered on two large reactors can produce water to grow food for several million people and can supply power to industries producing fertilizer and other electrochemical products. Selected crops and industrial products, selling at current world prices, can produce a return on investment estimated to be in the range of 10 to 20% per year. Total capital costs are estimated between 500 to 1500 million dollars, depending on size and other variables. Information has been developed for industrial complexes without desalting and for various sizes of farming areas up to about 200,000 acres in summer and 280,000 acres in winter using the output of a 1 BGD desalination plant. A town of 30,000 to 60,000 people is required for workers, their families, and supporting services and is included in cost estimates. Results of the work are encouraging.
W70-01750

VALUE OF WATER USED FOR SUPPLEMENTAL IRRIGATION IN ENGLAND AND WALES,
Ministry of Agriculture, Fisheries and Food, London (England).
C. N. Prickett.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 125-44. 9 tab, 10 ref. (IAEA STI/PUB/210, 1969). Was Paper PL-264/9 at meeting.
Identifiers: *Agriculture, *Water costs estimate, *Water utilization, Capitalized costs, Land utilization.

The paper gives data concerning the marginal costs and returns attributable to supplemental irrigation in the humid climatic conditions of England and Wales. Costs are divided into internal and external costs. Internal costs are those incurred within the farm boundary for receiving, storing, and distributing the water to the crops. External costs are water charges for abstraction from surface or groundwater sources, or charges for a piped supply from the general public system. Some theoretical estimates are also made of the external costs involved in supplying and distributing water to a number of farms in a designated irrigation area. For comparison with the costs, estimates are given of the likely effects of irrigation in terms of increased yields and increased gross margins per acre-inch of water applied. In making comparisons allowance would need to be made for the increased costs if desalted water were used. Comparisons indicate that there is little scope for use of desalted water for irrigation in England and Wales, with a possible exception of the irrigation of high-value crops in an area immediately adjoining a generating station.
W70-01751

INSTITUTO NACIONAL DE COLONIZACION, MADRID (SPAIN),
Cost of Irrigation Water in Spain.
A. Murcia, and A. M. Maqueda.
In Proc Panel, Value to Agriculture of High-quality Water from Nuclear Desalination, Vienna 1967, p 111-23 (IAEA STI/PUB/210, 1969). Was Paper PL-264/4 at meeting.
Identifiers: *Agriculture, *Spain, *Water costs estimate, *Water utilization, Capitalized costs, Land utilization.

A prerequisite to the study of agricultural applications of water from nuclear desalination plants is a knowledge of the economic value of the water. Owing to the lack of rainfall in arid countries, water may be considered as the main factor governing agricultural production and its economic value, up to the maximum, may be arrived at by crediting the entire increase in production achieved through the use of irrigation water to that factor alone. There is also another, minimum value, arrived at by adding the annual cost of the implementing the project and the cost of operating the works and facilities. The paper outlines methods for calculating such values, as well as an additional, weighted, value obtained by attributing to the water only part of the savings achieved. There follows an itemization of the prices currently paid by Spanish farmers for irrigation water in valleys where the commodity is scarce and in those where it is abundant, together with indications of the prices they might have to pay, depending on circumstances, for high-quality desalted water.
W70-01752

VALUE TO AGRICULTURE OF HIGH-QUALITY WATER FROM NUCLEAR DESALINATION.
International Atomic Energy Agency, Vienna (Austria).

IAEA STI/PUB/210, 1969, Proc Panel, Vienna 1967. 278 p, 53 fig.
Identifiers: *Agriculture, *Land utilization, *Nuclear desalination, *Water utilization, Agro-industrial complexes, Agronomy, By-product economics, Economic evaluations, Feasibility study, Fertilizer, Nuclear energy sources, Reviews, Water costs estimate, Water sources.

Report of a panel organized by the IAEA and held in Vienna, from 30 October to 3 November 1967. The meeting was attended by 30 experts from 13 countries and 3 international organizations. The contents include papers in which some economic and agricultural aspects are discussed, such as the value to agriculture of high-quality water from nuclear desalination, cost of irrigation water, water quality and yield depression, tolerance of certain crops to salinity and agronomic aspects of irrigation with brackish water. A conversion table is given in an annex. Each paper is in its original language (19 English and 3 French) and is preceded by an abstract in English with one in the orginal language if this is not English. Discussions are in English.
W70-01761

ATRIPLEX POLYCARPA: I. GERMINATION AND GROWTH AS AFFECTED BY SODIUM CHLORIDE IN WATER CULTURES,
California Univ., Riverside. Dept. of Agronomy.
For primary bibliographic entry see Field 02I.
W70-01800

BORON TOLERANCE OF TALL WHEATGRASS,
Department of Agriculture, Lincoln, Nebr.
For primary bibliographic entry see Field 03F.
W70-01825

SOME EFFECTS OF HIGH SALINITY ON GERMINATION AND EMERGENCE OF BARLEY,
Arizona Agricultural Experiment Station, Tucson.
T. J. Donovan, and A. D. Day.
Agronomy Journal, Vol 61, No 2, Mar-Apr 1969, p 236-238. 3 tab, 9 ref.

Descriptors: *Salinity, *Barley, *Plant growth, *Salt tolerance, *Germination, Arid lands, Soil-water-plant relationships, Saline soils, Seeds, Plant physiology, Arizona, Saline water.
Identifiers: Emergence (Seedlings).

Salinity frequently limits crop production in arid and semiarid agricultural regions. Thirty-nine barley varieties and lines were germinated in distilled water and in a water and sandy loam culture salinized to various concentrations. Most commercial varieties of barley had lower germination rates than did California Mariout and several saline tolerant strains developed by the USDA. Emergence in salinized soils was comparable to germination in water solutions. At moderate salinity levels most of the barleys performed well. At high salinity only the California Mariout and the salt tolerant strains were satisfactory. All the barleys were delayed in emergence in the highly saline media. In saline areas, tolerant barleys should be used, or if irrigation practices permit maintenance of low salinity during germination, higher salinity at later stages may not greatly affect yields. Laboratory methods are useful in screening barley varieties but should be supplemented by field trials. (Crouse-Arizona)
W70-01826

BENEFICIAL USES OF THERMAL DISCHARGE,
New York State Dept. of Commerce, Albany, and State Univ. of New York, Albany Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 05C.
W70-01922

INTEGRATION OF WATER REQUIREMENTS IN ARID AREAS BY MEANS OF DUAL-PURPOSE PLANTS FOR THE DESALINATION OF SEA WATER AND PRODUCTION OF ELECTRIC POWER. OPERATIONAL RESULTS OBTAINED BY THE ITALSIDER PLANTS AT TARANTO, ITALY (IN ITALIAN),
Societa Italiana Implanti, Genoa.
For primary bibliographic entry see Field 03A.
W70-01947

3E. Conservation in Industry

THE SELECTION OF NUCLEAR POWER AND DESALINATION PLANTS FOR AUGMENTING EXISTING WATER RESERVES,
Associated Nuclear Services, London (England).
H. A. Mathews, E. F. O. Masters, and F. K. Orde.
Preprint of Paper SM-113/51 Presented at IAEA Symp Nucl Desalination, Madrid, Nov 18-22, 1968. 33 p, ref, 5 fig.
Identifiers: *Water utilization, Dual-purpose plant, Energy sources, Fossil fuels, Load factor, Load following, Nuclear desalination, Nuclear energy sources, Water costs estimate, 0-50 MGD plant, 0-500 MW (E) reactors.

Whereas nuclear desalination is usually discussed and studied in the context of large capacities and high levels of utilization, implying base load requirements of high order of production, the possibility is considered here of utilizing reactors of the lower range of output to meet less favorable demands likely to occur before development of the ideal large-scale nuclear desalination plants. Ways are discussed of best employing reactors, power systems and water systems to obtain the most economic solution. It is suggested that the high availability characteristics of nuclear reactors may be exploited for this purpose. Attention is given to desirable characteristics of desalination plants and attainment of lower water costs.
W70-01718

PUMPED STORAGE - THE HANDMAIDEN OF NUCLEAR POWER,
Northeast Utilities Service Co., Hartford, Conn.
For primary bibliographic entry see Field 03A.
W70-01951

3F. Conservation in Agriculture

EFFECTS OF PETROLEUM MULCH ON SOIL WATER CONTENT AND SOIL TEMPERATURE,
Oregon State Univ., Corvallis. Dept. of Soils.
For primary bibliographic entry see Field 02G.
W70-01651

PROFILE MODIFICATIONS OF A SLOWLY PERMEABLE SOIL,
Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
For primary bibliographic entry see Field 02G.
W70-01656

THE ESTIMATION AND OCCURRENCE OF AGRICULTURAL DROUGHT,
Department of Agriculture, Ashburton (New Zealand). Winchmore Irrigation Research Station.
D. S. Rickard, and P. D. Fitzgerald.
J Hydrol (New Zeal), Vol 8, No 1, p 11-16, 1969. 6 p, 1 fig, 5 tab, 5 ref.

Descriptors: *Droughts, *Statistical methods, *Moisture deficit, Correlation analysis, Probability, Forecasting, Water shortage, Evapotranspiration, Soil moisture, Climatology, Estimating.
Identifiers: New Zealand.

Agricultural drought is defined as existing when the soil moisture in the root zone is at wilting point or below. The occurrence and distribution of agricultural drought was determined for 41 seasons in Mid Canterbury, New Zealand by calculating the day-by-day changes in soil moisture. This calculation was based on a Thornthwaite estimate of daily evapotranspiration modified to allow for the effect of decreasing soil moisture, and programmed for a digital computer. The average number of days of agricultural drought per season was 40, varying from none to 88. Approximately two-thirds of all drought days occurred during the summer months. The distribution of the longest drought in each season conforms to extreme-value theory; this showed that very severe periods of drought of 30 days or more could be expected once every 5 years. Highly significant correlations were obtained between seasonal nonirrigated pasture production and the number of days of agricultural drought. (Knapp-USGS)
W70-01687

DESIGN OF RECIRCULATING IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, Idaho. Northwest Branch Soil and Water Conservation Research Div.
James A. Bondurant.
American Society of Agricultural Engineers, Transactions, Vol 12, No 2, 1969, p 195-198, 201. 6 fig, 3 ref.

Descriptors: *Runoff, *Water reuse, *Irrigation systems, *Surface irrigation, *Irrigation efficiency, Irrigation water, Idaho, Farm equipment, Operating costs, Irrigation engineering, Agricultural engineering, Equations, Arid lands, Design criteria, Pumping plants, Cost analysis, Flow rates, Water utilization.
Identifiers: *Recirculating irrigation systems.

Irrigation is necessary for many crops in arid or semiarid regions. When water costs are high or when it is desirable to control surface flow of silt and chemical contaminents in irrigation runoff water, a recirculation system may be considered. When irrigation runoff is collected it should be recirculated to a different field. Maximum improvement in efficiency is achieved by using stored runoff water to reduce stream size for cutback irrigation. A design example is given for an Idaho farm of 105 irrigated acres. A method is presented for determining amount and rates of runoff and time and size of cutback. Since annual operating costs depend to a large extent on design and efficiency of the pumping installation, great emphasis is placed on these factors. The necessary design data are listed and the equations for design calculations are given. (Crouse-Arizona)
W70-01799

ATRIPLEX POLYCARPA: I. GERMINATION AND GROWTH AS AFFECTED BY SODIUM CHLORIDE IN WATER CULTURES,
California Univ., Riverside. Dept. of Agronomy.
For primary bibliographic entry see Field 02I.
W70-01800

COMPARISON OF INDEXES RELATING PLANT RESPONSE TO SOIL MOISTURE STATUS,
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center; and Hebrew Univ., Jerusalem (Israel). Dept. of Agriculture.
E. Rawitz, and D. I. Hillel.
Agronomy Journal, Vol 61, No 2, March-April 1969, p 231-235. 2 tab, 9 fig, 16 ref.

Descriptors: *Irrigation practices, *Soil-water-plant relationships, *Plant growth, *Soil moisture, *Crop response, Arid lands, Semiarid climates, Tensiometers, Growth chambers, Agronomy, Irrigation efficiency, Moisture availability, Timing, Crop production.
Identifiers: *Israel, *Soil suction, *Capillary suction index, Negev Desert.

Although plant response to soil moisture is affected by many factors, a single-value index is practical for determining timing and amount of irrigation. Comparisons of several indexes were made on the basis of dry matter yield of plants in growth chambers using soils from the arid Negev region of Israel. The mean maximum capillary suction index (using the minimum moisture content of each irrigation cycle) was the most practical. It is a relatively simple measure for a given soil where the affect of modifying factors is known or is fairly constant. The negative yield increment per unit suction decreased sharply to a fairly constant low value after a suction of about 1.5 bars. In the field such conditions are common during summer growing seasons in arid or semiarid Mediterranean climates. For practical field application it is suggested that suction be measured directly by tensiometer or calibrated electrical resistance units. (Crouse-Arizona)
W70-01801

FALL CHISELING FOR ANNUAL CROPPING OF SPRING WHEAT IN THE INTERMOUNTAIN DRYLAND REGION,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center; and Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center.
T. W. Massee, and F. H. Siddoway.
Agronomy Journal, Vol 61, No 2, p 177-181, Mar-Apr 1969. 2 tab, 5 fig, 12 ref.

Descriptors: *Dry farming, *Chiselling, *Soil-water-plant relationships, *Wheat, *Fallowing, Cultivation, Plant growth, Soil moisture, Agriculture, Semiarid climates, Idaho, Water utilization, Crop production, Great Plains, Moisture availability.
Identifiers: *Plots, Water use efficiency, Cropping.

Dryland agricultural production is largely limited by available water for plant growth. Various fallowing operations are practised to increase soil water supply for the next crop. An experiment was conducted in Idaho to test the effectiveness on wheat production of annual cropping, annual cropping with fall chiseling, and spring wheat-fallow rotation with chiseling after harvest. Monthly precipitation was a nearly uniform 2.5 cm., but cropping season precipitations averaged only 9.1 cm. In a 180 cm. soil depth annually cropped fall-chiseled plots averaged 21.3 cm. available stored water; cropped-fall chiseled-fallowed plots averaged 22.9 cm; and annually cropped plots averaged only 15 cm. (Crouse-Arizona)
W70-01802

GRASS SEEDING IN THAL, WEST PAKISTAN,
For primary bibliographic entry see Field 02I.
W70-01808

COST-BENEFIT ANALYSIS OF PASTURE IMPROVEMENT IN THE ARID REGION OF RAJASTHAN,
Agro-Economic Research Centre, Vallabh Vidyanagar (India).
N. S. Jodha.
Annals of Arid Zone, Vol 7, No 2, p 250-257, 1968. 2 tab, 8 ref.

Descriptors: *Pasture management, *Range management, *Economic feasibility, *Arid lands, *Cost-benefit analysis, Interest rate, Cost-benefit ratio, Grazing, Range grasses, Contour furrows, Vegetation regrowth, Land reclamation, Data collections.
Identifiers: *Reseeding, *Rajasthan, India.

Nearly 315 of the state of North-Western Rajasthan (about 214,000 sq. kms.) is arid land. The sandy soils are susceptible to erosion and support only sparse vegetation. In spite of increasing competition for crop land, available grazing land decreased while livestock population increased over 50% in the decade from 1951-1961. In order to utilize the limited soil moisture to maintain productive grazing land, scientifically and economically sound range management practices are essential. Experimental studies have developed two methods that offer possibility of raising the productivity of grazing lands: range reseeding and contour furrowing (to conserve moisture). Cost-benefit analysis of both methods is presented using an interest rate of 9 percent. With an estimated project life of 15 years, reseeding had a cost-benefit ratio of 1:3.47, while contour furrowing had a ratio of 1:5 on a ten year basis. (Crouse-Arizona)
W70-01809

AUSTRALIA'S ARID RANGELANDS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
R. A. Perry.
Annals of Arid Zone, Vol 7, No 2, p 244-249, 1968. 2 fig, 9 ref.

Descriptors: *Arid lands, *Range management, *Economic feasibility, *Grazing, *Resource development, Soil-water-plant relationships, Soil moisture, Erosion control, Simulation analysis, Ecosystems, Computers, Ranges, Land tenure, Rainfall, Sheep, Cattle.
Identifiers: *Australia.

Australia's arid lands are defined as those on which rainfall is not adequate for crop production. Seasonal distribution of rainfall, its reliability and evaporative potential together with total rainfall are considered in delineating the area where cropping is not economically feasible. Australia has some 2,2000,000 sq. miles which might be considered arid by the definition used. About half this area consists of sand plains or dune fields unsuitable for grazing. The remainder supports about 4.5 million cattle and 48 million sheep. An extensive system of management is used which gives efficient returns to capital. Carrying capacity must be adjusted in each area to obtain optimum sustained production from the limited available moisture. The land tenure system is unique: all land is owned by state governments and leased on long-term basis. The State retains power to influence land management to the extent that basic knowledge is available. The grazing industry operates in a delicate ecosystem that could easily be upset with irreversible deterioration. An objective of the grazing research program is knowledge of the functional relationships of the ecosystem so that grazing management experiments can be simulated in a computer. (Crouse-Arizona)
W70-01810

IMPROVING SEMIDESERT RANGES IN SOUTHERN ARIZONA, U.S.A. BY GRAZING MANAGEMENT AND SHRUB CONTROL,
Forest Service (USDA), Tucson, Ariz. Rocky Mountain Forest and Range Experiment Station.
S. Clark Martin.
Annals of Arid Zone, Vol 7, No 2, p 235-242, 1968. 2 tab, 2 fig, 12 ref.

Descriptors: *Semiarid climates, *Range management, *Weed control, *Mesquite, *Desert plants, Grasslands, Stocking, Grazing, Arizona, Forage grasses, Southwest U.S., Cacti, Rainfall, Shrubs, Soil moisture.
Identifiers: Burroweed, Perennial grasses.

The 50,000 acre Santa Rita Experimental Range in southern Arizona is representative of nearly 20 million acres of semidesert grass-shrub range in the southwestern U.S. The vegetation which can best utilize limited moisture supply to support economically feasible grazing is perennial grass. Without careful range management, the land is invaded by weed shrubs and small trees which use available soil moisture and permit only limited grazing. Shrubs may be controlled by chemicals or, under certain conditions, by fire. Chemicals applied by ground spray or by air will kill mesquite. When stocking was adjusted to utilize 40% of the forage, yields doubled in three years; when shrubs and mesquite were controlled, grass yields increased 3 1/2 times. When the grasses were allowed to occupy more of the root zone, they were able to utilize for forage production more of the soil moisture before it evaporated. (Crouse-Arizona)
W70-01811

PAPAGO FLOODWATER PASTURES SHOW PROMISE,
Arizona Univ., Tucson; and Bureau of Indian Affairs, Papago Indian Reservation, Ariz.
For primary bibliographic entry see Field 03B.
W70-01813

WATER PRIORITY RIGHTS AND THEIR EFFECT ON FARM PLANNING IN THE SAN CARLOS IRRIGATION AND DRAINAGE DISTRICT IN CENTRAL ARIZONA,
Arizona Agricultural Experiment Station, Tucson.
Aaron G. Nelson, and P. Thomas Cox.
University of Arizona, Agricultural Experiment Station, Technical Bulletin 184, 1968. 48 p, 20 tabs, 4 fig.

Descriptors: *Arizona, *Irrigation districts, *Probability, *Economics, *Water allocation (Policy), Arid lands, Irrigated land, Water rates, Farm prices, Costs, Profits, Institutional constraints, Priorities, Indian reservations, Water storage, Pumped storage, Dams, Watersheds (Basins).
Identifiers: *San Carlos Irrigation and Drainage District (Ariz), *Gila River.

Water is the most limiting factor with which farmers operating in the San Carlos Irrigation and Drainage District in central Arizona must contend. Yet the institutional environment is such that they must make decisions without full knowledge of and only negligible control over their water supply. The objectives of this paper are to increase available knowledge of institutional constraints and reduce uncertainties of decision making. Priorities and apportionment of natural flow and pumped and stored water are described. Probabilities of receiving certain amounts of water in a given period are calculated. From those probabilities graphs were developed to show probable marginal gain and loss per water period for specified crops with different levels of costs and prices. (Crouse-Arizona)
W70-01814

A PRELIMINARY FIELD STUDY OF SURFACE TREATMENTS FOR RUNOFF INDUCEMENT IN THE NEGEV OF ISRAEL,
Hebrew Univ., Jerusalem (Israel). Dept. of Agriculture; and National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03B.
W70-01820

USE OF CONTROLLED ENVIRONMENT FOR VEGETABLE PRODUCTION IN DESERT REGIONS OF THE WORLD,
Arizona Univ., Tucson. Environmental Research Lab.; and Sonora (Univ.) Hermosillo (Mexico).
Merle H. Jensen, and Marco Antonio Teran.
American Society for Horticultural Science, 66th Annual Meeting, Aug 20-22, 1969, Pullman, Washington, Paper Presented. 12 p, 5 tab.

Descriptors: *Greenhouses, *Arid lands, *Soil-water-plant relationships, *Irrigation efficiency, *Vegetable crops, Irrigation practices, Environmental effects, Fertilization, Plant diseases, Mexico, Calcium, Beaches, Leaching, Plastics, Pollen, Pest control, Nutrients, Planting management, Saline water, Sands.
Identifiers: *Controlled environment, *Sonora, Mexico, Gulf of California, Puerto Penasco.

The authors report on a pilot program to grow a variety of edible vegetables in a controlled environment on the arid coast of Sonora, Mexico at Puerto Penasco. Air-inflated plastic greenhouses are used

to minimize consumption of scarce fresh water and provide protection from insects and sandstorms. Beach sand is used as a medium after leaching to remove excess salts. Nutrients are supplied through the irrigation system. Air inside the greenhouse is circulated through a spray of seawater which maintains relative humidity close to 100%, and reduces fresh water irrigation requirements to a minimum. Yielus were high - comparable to those of conventional greenhouses. Disease problems were limited to easily controlled fungus infection. (Crouse-Arizona)
W70-01822

THE GEZIRA SCHEME: A STUDY IN AGRICULTURAL DEVELOPMENT,
William A. Hance.
In: William A. Hance, African Economic Development, Rev ed, New York, Praeger, 1967, p 31-53.

Descriptors: *Arid lands, *Land tenure, *Irrigation operation and maintenance, *Marketing, *Agriculture, Diversion dams, Irrigation practices, Hydroelectric plants, Farm management, Clays, Social impact, Economic impact, Cotton, Multipurpose projects.
Identifiers: *Sudan, *Africa, *Nile River, *Gezira Scheme.

The Gezira Scheme which started in the 1920's, lies south of Khartoum, Sudan, between the White Nile and Blue Nile. The naturally arid land is irrigated by diversion from the Blue Nile. A total area of about 1,870,000 acres is involved, of which about 58 percent is irrigated each year. Principal crops are cotton and food and feed grains. Average tenancy is about 30 acres and is worked largely by hand methods. Most of the land is government owned but alloted to and worked by original residents of the area. It is worked under a partnership arrangement among tenants, government and public utilities which manages the water works, marketing and research and which offer managerial guidance. General economic and educational levels of tenants and hired help have been raised to a favorable level and needed revenues are derived by the government, although individual initiative has been limited by the partnership arrangement. The scheme has been copied elsewhere in Africa with varying degrees of success and offers at least one workable approach to agricultural development of the arid zones of Africa. (Crouse-Arizona)
W70-01823

BORON TOLERANCE OF TALL WHEATGRASS,
Department of Agriculture, Lincoln, Nebr.
Gerald E. Schuman.
Agronomy Journal, Vol 61, No 3, May-June 1969, p 445-447. 1 tab, 4 fig, 7 ref.

Descriptors: *Boron, *Wheatgrasses, *Arid lands, *Plant growth, *Toxicity, Germination, Nutrients.
Identifiers: *Boron toxicity, Nutrient culture.

Some of the unproductive arid lands of the western United States have less vegetation than actual rainfall might support because of high boron levels in the soil. Experiments were conducted with three varieties of tall wheatgrass in nutrient solutions with boron content ranging from 0 to 150 ppm. One variety, Alkar, was also tested in sandy loam. In the nutrient solutions the B level, which effected a 50% reduction in growth, ranged from 33 to 38 ppm. Growth of the Alkar variety in soil was reduced to 50% at a B level of 46 ppm in the saturation extract. The author concluded that tall wheatgrass may be economically feasible for reseeding arid land with boron levels as high as 35 ppm. Germination was not adversely affected by boron in the soil. (Crouse-Arizona)
W70-01825

PLANT DENSITY AND YIELD OF SUGAR BEETS IN AN ARID ENVIRONMENT,
California Univ., Davis. Dept. of Water Science and Engineering; and California Univ., Davis. Dept. of Agronomy.
Frank E. Robinson, and George F. Worker, Jr.
Agronomy Journal, Vol 61, No 3, May-June 1969, p 441-443. 5 tab, 1 fig, 20 ref.

Descriptors: *Sprinkler irrigation, *Arid lands, *Sugar beets, *California, *Crop production, Germination, Crop response, Spatial distribution, Plant populations.
Identifiers: Dry matter, Sucrose.

Use of sprinkler irrigation permits flexibility in spacing arrangements and density of plants. An experiment testing four different spacings of sugar beet plants was run to determine the yield of sucrose in relation to plant density per hectare of sprinkler irrigated arid land. The highest yield of sucrose with square grid spacing was obtained with approximately 100,000 plants per hectare. Maximum yield spacing for the sprinkler irrigated arid area tested was similar to that found in well watered European regions. (Crouse-Arizona)
W70-01827

SPRINKLER IRRIGATION IN ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Engineering.
A. D. Halderman, and K. R. Frost.
Arizona University, Cooperative Extension Service and Agricultural Experiment Station, Bulletin A-56, Dec 1968. 30 p, 13 fig, 3 tab.

Descriptors: *Arid lands, *Arizona, *Sprinkler irrigation, *Irrigation design, *Irrigation systems, Economic justification, Initial costs, Operating costs, Temperature control, Frost protection, Agricultural engineering, Cost analysis, Irrigation efficiency.

Sprinkler irrigation is considered as a method of improving efficiency of water use by agriculture in arid Arizona. This bulletin is intended to supply growers with information needed to make decisions concerning installation of sprinkler irrigation systems. Advantages include possibilities of irrigating rough land; light, frequent irrigations for better soil moisture control; relatively uniform and efficient distribution; alleviation of soil erosion and excessive loss to deep percolation; more efficient field machinery operations; frost control; and fertilizer application. However, additional power is required to provide pressure and initial installation may be more costly. Diagrams, tables and discussion are presented to guide the operator in decisions on system design, selection of type of system, volume of water required, operation, and economics of sprinkler irrigation. (Crouse-Arizona)
W70-01832

BASIC PROBLEMS OF THE TRANSFORMATION OF NATURE IN CENTRAL ASIA,
Akademiya Nauk SSSR, Moscow. Institut Goegrafii.
I. P. Gerasimov.
Translation from Problemy Osvoyeniya Pustin, No 5, p 3-17, 1967. Soviet Geography: Review and Translation Vol 9, No 6, p 444-458, June 1968. 1 tab.

Descriptors: *Grazing, *Arid lands, *Soil surveys, *Irrigable land, *Agriculture, History, Range management, Soil types, Semiarid climates, Runoff, Saline soils, Resource development, Hydrologic cycle, Water balance, Land reclamation, Drainage, Geographic regions, Salt balance.
Identifiers: *U.S.S.R., *Central Asia, *Physical geography.

The author presents a broad view of the problems involved in rational expansion of irrigated agriculture and grazing in Central Asia to their full potential. Present investigations are of two types: historical and soil and physical-geographic studies. Historical research indicates that at one time 8-10 million ha. were irrigated at sometime in Central Asia, far more than at present. Assuming current technology, at least 10.2 million ha. in desert and semiarid regions of Central Asia are irrigable. Many soil types are involved, including large areas with salinity problems. Grazing lands that have permanent forage plants might support 25-30 million sheep - far more than present flocks. Dependable watering installations and better surveys of natural productivity of grazing lands are needed to meet this potential. The Institute of Geography has attempted to define problems requiring interdisciplinary research to achieve the full potential of Central Asia. (Crouse-Arizona)
W70-01836

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

MAN AND NATURE AT ODDS IN THE DELTA,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 06G.
W70-01642

DIVERSION BY LAKE PIERCING, SNETTISHAM PROJECT,
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 08B.
W70-01661

THE PREDICTION OF EVAPORATION, DRAINAGE, AND SOIL WATER STORAGE FOR A BARE SOIL,
Wisconsin Univ., Madison. Dept. of Soil Sciences.
For primary bibliographic entry see Field 02G.
W70-01664

FLOOD PLAIN INFORMATION OF YELLOWSTONE RIVER: VOLUME 1 - BILLINGS METROPOLITAN REGION, MONTANA,
Corps of Engineers, Omaha, Nebr.

Corps Eng Flood Plain Rep, Oct 1969. 17 p, 8 plate, 5 tab.

Descriptors: *Flood, *Flood damage, *Montana, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Yellowstone River (Mont), Billings (Mont), Standard project flood, Intermediate regional flood.

Flooding of the Yellowstone River, Billings, Montana is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-01681

FLOOD PLAIN INFORMATION, KENAI RIVER, ALASKA.
Corps of Engineers, Anchorage, Alaska.

Corps Eng Flood Plain Rep, Apr 1967. 11 p, 1 fig, 5 exhibit, 25 map, 17 ref.

Descriptors: *Floods, *Flood damage, *Alaska, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Kenai River (Alaska), Standard project flood, Intermediate regional flood.

Flooding of the Kenai River, Alaska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-01682

FLOOD PLAIN INFORMATION, SHENANDOAH RIVER, CLARKE COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.

Corps Eng Flood Plain Rep, Feb 1969. 25 p, 3 fig, 12 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Shenandoah River (Va), Clarke County (Va), Standard project flood, Intermediate regional flood.

Flooding of the Shenandoah River in Clarke County, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-01683

BULKHEAD LINE: THE LIFELINE OF OUR COASTS,
Tom Adams.
In the Capitol, Vol 7, No's 9, 10, p 1-3, Sept, Oct 1969. 3 p.

Descriptors: *Florida, *Bulkhead line, *Landfills, *Water pollution, Coasts, Coastal engineering, Coastal structures, Shores, Shore protection, Land forming, Land reclamation, Land management, Land resources, Administration, Legislation.
Identifiers: Recommended legislation.

The bulkhead line is an imaginary line in a body of water beyond which no land filling is permitted. Bulkhead lines are important to Florida because haphazard filling can cause water pollution and the destruction of marine and bird sanctuaries. The Trustees of the Internal Improvement Fund manage Florida's coastal land resources. They have established a uniform policy on bulkhead lines based on the mean high water mark. The Trustees have set penalties for illegally filling coastal areas. However, permanent legislation is needed to establish bulkhead lines and construction setback lines along our coastlines. (McDonough-Florida)
W70-01704

DRAINAGE DISTRICTS.
For primary bibliographic entry see Field 06E.
W70-01772

DESIGN OF RECIRCULATING IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, Idaho. Northwest Branch Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 03F.
W70-01799

THE ACHIEVEMENTS OF DRAINAGE THEORY IN RELATION TO PRACTICAL NEEDS: TAKING STOCK,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
For primary bibliographic entry see Field 02G.
W70-01817

REGIONAL CONSIDERATION OF FLOOD PLAIN PLANNING,
Bi-State Metropolitan Planning Commission for Scott County, Iowa and Rock Island County, Ill.
For primary bibliographic entry see Field 06B.
W70-01837

TECHNIQUES FOR DEVELOPING A COMPREHENSIVE PROGRAM FOR FLOOD PLAIN MANAGEMENT,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 06B.
W70-01838

MAN SHOULD MANAGE THE FLOOD PLAINS,
For primary bibliographic entry see Field 06B.
W70-01839

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Buenos Aires Univ. (Argentina).
For primary bibliographic entry see Field 06B.
W70-01844

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY) (IN FRENCH),
Bundesverkehrsministerium, Bonn (West Germany).
For primary bibliographic entry see Field 06B.
W70-01845

GENERAL REPORT: (METHODS FOR ASSESSING THE TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Ingenieur General dea Ponts et Chaussees.
For primary bibliographic entry see Field 06B.
W70-01846

PAPER: (DETERMINING THE CAPACITY OF THE ST. LAWRENCE SEAWAY),
St. Lawrence Seaway Development Corp.
For primary bibliographic entry see Field 06D.
W70-01847

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Netherlands Rijkswaterstaat, The Hague.
For primary bibliographic entry see Field 06B.
W70-01848

PAPER: (TRANSPORT CAPACITY OF AN ARTIFICIAL WATERWAY) (IN FRENCH),
Navigazione Interna e Trasporti Internazionali, Milan (Italy).
For primary bibliographic entry see Field 06B.
W70-01849

PAPER: (EVALUATION OF THE TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY) (IN FRENCH),
For primary bibliographic entry see Field 06B.
W70-01850

THEORY AND EXPERIMENT IN CANAL SEEPAGE ESTIMATION USING RADIOISOTOPES,
Bhabha Atomic Research Center, Bombay (India). Isotope Div.
For primary bibliographic entry see Field 02G.
W70-01858

DRAINAGE DESIGN THEORY AND PRACTICE,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
For primary bibliographic entry see Field 02A.
W70-01877

DRAINAGE DENSITY AS AN INDICATOR OF BASE FLOW IN PART OF THE POTOMAC RIVER BASIN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-01896

AQUATIC WEED CONTROL WITH SODIUM ARSENITE,
Wisconsin State Board of Health, Madison. Committee on Water Pollution.
For primary bibliographic entry see Field 05G.
W70-01939

SHORE DEVELOPMENT AND PRESERVATION.
For primary bibliographic entry see Field 06E.
W70-01997

SURVIVAL OF QUERCUS TURBINELLA AND Q. EMORYI SEEDLINGS IN AN ARIZONA CHAPARRAL COMMUNITY,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station.
C. P. Pase.
Southwestern Naturalist 14 (2):149-155, Oct 10, 1969.

Descriptors: *Chaparral, *Oak trees, *Succession, Effects, Competition, Growth stages, *Burning, Environmental phenology.
Identifiers: *Prescribed fire, Seedling establishment.

Naturally occurring seedlings of shrub live oak (Quercus turbinella) and Emory oak Q. emoryi are uncommon, but a moderate population was observed in August 1963 on chaparral strips burned 1 and 2 years previously. After 3 years, survival of shrub live oak seedlings was 26 percent, and Emory oak, 27 percent. Nearly all mortality was attributed to drought. It is hypothesized that rainfall is suitable for oak seedling germination and establishment only 1 year in 10. Critical moisture values suggested are 15 inches or more of October-March precipitation, followed by 10 inches or more of July-September rainfall. (Author)
W70-02041

4B. Groundwater Management

ARTIFICIAL RECHARGE TO THE SNAKE PLAIN AQUIFER IN IDAHO; AN EVALUATION OF POTENTIAL AND EFFECT,
Geological Survey, Washington, D.C.
R. F. Norvitch, C. A. Thomas, and R. J. Madison.
Idaho Dep Reclam Water Inform Bull No 12, Aug 1969. 59 p, 14 fig, 3 tab, 26 ref.

Descriptors: *Water resources development, *Artificial recharge, *Water management (Applied), *Analog models, *Idaho, Aquifers, Hydrogeology, Streamflow, Groundwater movement, Water quality, Water levels, Discharge (Water), Hydrologic data, Data collections, Water wells, Permeability, Transmissivity.
Identifiers: Snake River Plain aquifer (Idaho).

The major factors involved in using surplus water for artificial recharge of the Snake Plain aquifer in southern and southeastern Idaho are the availability of water, the effects of mixing on groundwater quality and aquifer properties, and the effects of artificial recharge on groundwater levels and discharge. About 5,100,000 acre-ft of water is recharged to the aquifer annually by irrigation. An average flow of about 1.3 million acre-ft or more

occurs at a rate of once every 2 yr. There probably will be no chemical-quality problems involved in large-scale recharge. A transient state, electric-analog model of the Snake Plain aquifer was constructed. Model predictions show that by recharging a total of 3.7 million acre-ft of water over a 10-yr period at 4 different places on the Plain, water-level rises of less than 1 to more than 5 ft, measured 21 months after recharge stopped, would occur. If water were added at 62,000 acre-ft per month for 3 continuous months at each place, once every 2 yr, over a 10-yr period, 3.3 million acre-ft would go into storage in the aquifer and 0.4 million acre-ft would flow out of the springs. (Knapp-USGS)
W70-01654

ARTIFICIAL GROUNDWATER RECHARGE - WET WALNUT CREEK,
Geological Survey, Lawrence, Kans. Water Resources Div.; and Kansas Water Resources Board, Topeka.
J. B. Gillespie, K. L. Lindskov, and S. E. Slagle.
Kans Water Resources Board Progr Rep No 1, Jan 1969. 22 p, 5 fig, 2 append.

Descriptors: *Artificial recharge, *On-site tests, On-site investigations, Water spreading, Irrigation water, Monitoring, Data collections, Hydrologic data.
Identifiers: Aquifer testing, Recharge ponds.

Preliminary work on an artificial recharge project at Wet Walnut Creek, Rush County, Kansas includes damsite studies, aquifer core sampling, collection of drillers' logs of wells in the area, and drilling of observation wells for aquifer testing. The available driller's log and core test information is tabulated. Descriptions are given of the work accomplished to date at each test site. (Knapp-USGS)
W70-01659

WATER RESOURCES APPRAISAL OF THE WARM SPRINGS--LEMMON VALLEY AREA, WASHOE COUNTY, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
For primary bibliographic entry see Field 03B.
W70-01806

A BRIEF APPRAISAL OF THE WATER RESOURCES OF THE WALKER LAKE AREA, MINERAL, LYON, AND CHURCHILL COUNTIES, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
For primary bibliographic entry see Field 03B.
W70-01807

PROJECTIONS OF NET INCOME AND WATER USE IN PINAL COUNTY, ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
William E. Martin, Thomas G. Burdak, and Robert A. Young.
Progressive Agriculture in Arizona, Vol 21, No 4, July-Aug 1969, p 3, 20. 1 tab.

Descriptors: *Agriculture, *Arizona, *Economics, *Net income, *Computers, Irrigation, Groundwater mining, Cost trends, Farm management, Linear programming, Analog computers, Digital computers, Arid lands, Water levels, Water table, Water utilization, Pumping.

Large-scale use of groundwater for irrigation in arid Pinal County of central Arizona has caused a rapid decline in water level. As the water level falls, pumping costs rise. The authors combined analog computer projections of the groundwater table made by the U.S. Geological Survey with a digital computer linear programming technique to obtain water use and cost projections based on the interrelated nature of agriculture and aquifer conditions. It was recognized that as pumping costs increase, farmers will change their agricultural activities. The conclusion was that while the water table will continue to decline, the rate will slow down in response to higher costs. Net farm income will decline gradually, with smaller farms most seriously affected. (Crouse-Arizona)
W70-01812

THE ORIGIN AND SPREAD OF QANATS IN THE OLD WORLD,
Texas Univ., Austin, Tex.
Paul Ward English.
American Philosophical Society, Proceedings, Vol 112, No 3, June 1968, p 170-181. 4 fig, 74 ref.

Descriptors: *Wells, *Underground structures, *Irrigated land, *Arid lands, Water rights, Water table, Social change, Construction costs, Tunneling, Institutional constraints, Water law.
Identifiers: *Qanats, *Armenia, *Persia (Iran), Arabia, North Africa, Central Asia, China.

The author reviews probable origin of the Qanat system more than 2,500 years ago in the region of Armenia and its spread to arid regions of Persia, Egypt, Arabia, North Africa, Central Asia, and even China. Qanats are gently sloping tunnels dug by hand down into an allovial fan until they intercept the water table. Water emerges in nearby lowlands, where it is used for irrigation and domestic purposes. In use over long periods, Qanats have influenced settlement patters and agriculture and have a complex set of customs that determine water rights. Although deep wells may be less costly to construct today, large numbers of existing Qanats exert a conservative force in support of continued existence of preindustrial social and economic conditions. (Crouse-Arizona)
W70-01830

OBSERVATIONS OF THE PRESSURE SURFACE IN THE AQUIFER OF AN IRRIGATION DISTRICT AT MERBEIN, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Merbein (Victoria). Div. of Horticultural Research.
For primary bibliographic entry see Field 02F.
W70-01857

BASE FLOW WELLS: RIO COBRE PROJECT, JAMAICA,
Humphreys (Howard) and Sons, Reading (England); and Water Research Association, Medmenham (England).
J. D. Williams, and A. Hunter Blair.
J Inst Water Eng, Vol 23, No 7, p 449-463, Oct 1969. 15 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Conjunctive use, *Base flow, *Groundwater, *Karst, *Analog models, *Low-flow augmentation, Model studies, Water wells, Alluvial channels, Pumping, Springs, Water supply, Water resources development.
Identifiers: *Jamaica (BWI), Rio Cobre (Jamaica).

To augment the resources of Kingston and St. Andrew, Jamaica, an inexpensive groundwater scheme, the Rio Cobre project, involves the development of three groundwater sources. Use of one of these sources, Tulloch Spring, would reduce the river flow available to the Rio Cobre irrigation system. An electric analog model was constructed to verify that seasonal pumping from groundwater storage can maintain the river base flow and compensate for abstraction at the spring. After modelling historic data, the performance of several alternative groups of base flow wells was tested. River flows can be maintained without impairing other interests in the aquifer, and the valuable Tulloch source can be developed as part of the project in this manner (Knapp-USGS)
W70-01891

HYDROGEOLOGIC RECONNAISSANCE OF THE CANARY ISLANDS, SPAIN,
Geological Survey, Lawrence, Kan.; and Ministry of Public Works (Canary Islands).
For primary bibliographic entry see Field 02F.
W70-01901

4C. Effects on Water of Man's Non-Water Activities

REVERSE AND DIRECT RESERVOIR ROUTING METHOD SETS HIGHWAY GRADE,
Ministry of Public Works, Caracas (Venezuela).
Constantine Voutyras.
Civil Eng, Vol 39, No 10, p 56-58, Oct 1969. 3 p, 4 fig, 1 photo.

Descriptors: *Routing, *Streamflow, *Floods, *Stage-discharge relations, *Embankments, Hydraulic design, Weirs, Discharge coefficients, Drainage, Spillway crests, Highway effects, Water levels, Overflow.
Identifiers: Rating curves, Venezuela.

Combined overflows from the Orinoco and Apure Rivers in Venezuela produced unprecedented flooding in the vicinity of a highway that was under construction. The partially built embankment acted as a dam, and because the flood was without precedence, the drainage system designed for the highway proved inadequate. The problem of providing proper drainage was aggravated by a lack of topographic and hydrologic data for the area. Information was gathered on water levels, high water marks and topography in the vicinity. By treating the embankment as a broad-crested weir, a rating curve for the 2.5-km (1.6-mile) spillway was developed, and an outflow hydrograph constructed from stage-discharge relationships. Then, employing reverse routing methods, an inflow hydrography was established. Repeated routing of this hydrograph was used in developing one graph of water elevation and total waterway span, from which the total drainage waterway opening required to prevent overtopping of the road was determined. (Knapp-USGS)
W70-01660

A MUDFLOW IN THE SECOND CREEK DRAINAGE, LAKE TAHOE BASIN, NEVADA, AND ITS RELATION TO SEDIMENTATION AND URBANIZATION,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02J.
W70-01899

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

MICROPARTICULATES: ISOLATION FROM WATER AND IDENTIFICATION OF ASSOCIATED CHLORINATED PESTICIDES,
Ohio State Univ., Columbus. Dept. of Microbial and Cellular Biology.
R. M. Pfister, P. R. Dugan, and James I. Frea.
Science, Vol 166, No 3907, p 878-879, Nov 1969. 2 p, 1 tab, 7 ref. OWRR Grants A-006-OHIO and A-013-OHIO.

Descriptors: *Pesticide kinetics, *Lakes, *Adsorption, *Suspended load, Gas chromatography, Path of pollutants, Pesticide residues, Laboratory tests, Sampling, Analytical techniques, Chlorinated hydrocarbon pesticides.
Identifiers: Microparticulates, Gas-liquid chromatography, Thin-layer chromatography.

Microparticulates suspended in lake water were collected by continuous centrifugation and either examined directly or placed on a linear sucrose gradient. Total residue as well as fractions of the centrifuged gradient were extracted with hexane and examined by gas chromatography for the presence of chlorinated hydrocarbon pesticides. Hexane extracts of total residues were also examined by thin-layer chromatography. Lindane and endrin were shown, by gas-liquid chromatography and thin-layer chromatography, to be associated with microparticles. These and other pesticides appeared to be selectively associated with microparticles of different densities, when gas-liquid chromatography was used, although concentrations were below the detection limits required for confirmation by thin-layer chromatography. Samples taken at different times from different locations in Lake Erie revealed different associations with hexane-soluble electron-capturing compounds. (Knapp-USGS)
W70-01669

DUAL COLUMN AND DERIVATIVE TECHNIQUES FOR IMPROVED SPECIFICITY OF GAS-LIQUID CHROMATOGRAPHIC IDENTIFICATION OF ORGANOCHLORINE INSECTICIDE RESIDUES IN SOILS,
Wisconsin Univ., Madison. Dept. of Soil Science.
H. B. Pionke, G. Chesters, and D. E. Armstrong.
Analyst, Vol 94, No 1123, p 900-903, Oct 1969. 4 p, 2 fig, 1 tab, 8 ref. Contract No 12-14-100-8154 (41), Agricultural Research Service.

Descriptors: *Analytical techniques, *Gas chromatography, *Insecticides, DDT, Instrumentation, Water analysis, Pollutant identification, Soil chemistry, Soil water.
Identifiers: TDE, Methoxychlor.

Derivatives of organochlorine insecticides exhibiting column time values substantially different from those of the parent insecticides were obtained for TDE, methoxychlor, and DDT on treatment with 2% ethanolic potassium hydroxide, and for endrin and dieldrin with ethanolic concentrated hydrochloric acid; partial clean-up of soil extracts was achieved by the alkali treatment. The use of dual colums, namely DC-200 and diethylene glycol succinate, in conjunction with derivative formation, provided column time values sufficiently different for improved organochlorine insecticide identification with minimal additional effort. (Knapp-USGS)
W70-01692

INVESTIGATION OF ORGANIC POLLUTION OF SURFACE WATERS BY ULTRAVIOLET SPECTROPHOTOMETRY,
Hydraulic Research Inst., Ostrava (Czechoslovakia).
Miroslav Mrkva.
J Water Pollut Contr Federation, Vol 41, No 11, Part 1, p 1923-1931, Nov 1969. 9 p, 5 fig, 2 tab, 22 ref.

Descriptors: *Pollutant identification, *Water pollution, *Organic wastes, *Spectrophotometry, *Ultraviolet radiation, Pollutants, Water pollution sources, Sampling, Laboratory tests.
Identifiers: Ultraviolet spectrophotometry.

To determine the organic content of surface waters, several methods may be employed, including ultraviolet spectrophotometry. Assuming that surface waters consist mainly of readily degradable organics and other lignum substances, three groups of surface water classifications were proposed. Absorbance spectra for each of the three ranges were 220 to 245 millimicrons for clean waters; 220 to 280 millimicrons for rivers with high concentrations of lignum sulfonates; and 270 millimicrons for rivers which received additional waste products (phenol, etc.). Coefficients to convert absorbance to organic concentration are given. Experiments to confirm the proposed wavelengths were performed on the river Odra in the Central European region showed that spectrophotometry can be used to describe the dissolved organic matter in rivers. (Knapp-USGS)
W70-01694

DEGRADATION OF SELECTED CHLORINATED HYDROCARBON INSECTICIDES,
Auburn Univ., Ala. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-01696

DDT IN ANTARCTIC SNOW,
Ohio State Univ., Columbus. Dept. of Environmental Science.
Tony J. Peterle.
Nature, Vol 224, No 5219, p 620, Nov 1969. 1 p, 21 ref.

Descriptors: *Pesticide residues, *Antarctic, *Snow, *DDT, Gas chromatography, Sampling, Surveys, Pesticide drift, Persistence.
Identifiers: *Antarctic snow, DDT residues.

Snow which fell in the Antarctic in 1966 and 1967 was collected and analyzed for DDT. Gas chromatography and thin-layer chromatography detected DDT in 3 of the 5 samples tested at levels of about 0.04 ppb. (Knapp-USGS)
W70-01697

A CLASSIFIED BIBLIOGRAPHY OF OIL POLLUTION,
University Coll. of Swansea (Wales). Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-01787

MAN-MADE CARBON-14 IN DEEP PACIFIC WATERS: TRANSPORT BY BIOLOGICAL SKELETAL MATERIAL,
Scripps Institution of Oceanography, La Jolla, Calif.; and Tata Inst. of Fundamental Research, Bombay (India).
B. L. K. Somayajulu, D. Lal, and S. Kusumgar.
Science, Vol 166, No 3911, p 1397-1399, Dec 1969. 3 p, 1 tab, 10 ref.

Descriptors: *Carbon radioisotopes, *Pacific Ocean, *Calcium carbonate, *Carbon cycle, *Fallout, Radioactive dating, Radioecology, Radiochemical analysis, Radioactivity effects, Tracking techniques, Sedimentation, Geochemistry.
Identifiers: Pacific Ocean carbon-14.

Calcareous particles present in Pacific waters at depths of 50 to 3500 meters were collected by filtering seawater through spongin matrix. The specific activity of carbon-14 could be measured in two of these collections from depths of 2300 and 3500 meters. The ratios of carbon-14 to carbon-12 correspond to values observed in surface waters in recent years as a result of the addition of manmade carbon-14, thus indicating that the calcareous particles resulted from recent biological productivity. The results are related to the mean settling rates and the sizes and dissolution rates of biogenic calcareous particles in transit through a seawater column. (Knapp-USGS)
W70-01871

FLOW-THROUGH SAMPLING SYSTEM FOR SMALL BOATS OR ICE SHELTER,
Geological Survey, Washington, D.C.; and Geological Survey, Fort Wayne, Ind.
For primary bibliographic entry see Field 07B.
W70-01900

THERMAL POLLUTION AS A FACTOR IN POWER PLANT SITE SELECTION,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.; and Gurnham, Bramer and Associates.
P. V. Morgan, and H. C. Bramer.
Paper presented at the Cooling Towers Institute Meeting-1969. 22 p, 2 tab, 2 fig, 3 ref.

Descriptors: *Thermal pollution, Ecology, Powerplants, Temperature, Model studies.
Identifiers: Site selection, Dispersion studies.

Industry today must determine that present or projected effluents will meet the water quality criteria set for receiving streams. This is of particular importance insofar as thermal pollution in connection with electric power generation is concerned. Baseline ecological and engineering studies should be integral parts of site selections and should precede land acquisition or construction planning. The power industry should be continually acquiring data as a matter of self interest to guard against unfounded charges and to institute optimum, least-cost abatement measures. Simultaneous measurements of a biological, chemical and physical nature allow ecological judgements to be made. Other techniques include aerial surveillance with infrared and other photographic monitoring, hydrological measurements, dye dispersion studies, mathematical and physical modeling, data processing, and economic evaluations. Such problems require a true multi-disciplinary approach by a group of scientific and engineering specialists. (Upadhyaya-Vanderbilt)
W70-01923

TDE RESIDUES IN CLEAR LAKE ANIMALS,
California State Dept. of Fish and Game, Sacramento. Wildlife Management Branch; and California State Dept. of Public Health, Sacramento. Food and Drug Lab.
For primary bibliographic entry see Field 05C.
W70-01935

OIL DISPERSING CHEMICALS, A STUDY OF THE COMPOSITION, PROPERTIES AND USE OF CHEMICALS FOR DISPERSING OIL SPILLS,
Federal Water Pollution Control Administration, Edison, N.J. Water Quality Lab.
For primary bibliographic entry see Field 05G.
W70-02037

5B. Sources of Pollution

PESTICIDES IN DRINKING WATER: WATERS FROM THE MISSISSIPPI AND MISSOURI RIVERS,
Consumer Protection and Environmental Health Service, Cincinnati, Ohio.
For primary bibliographic entry see Field 05F.
W70-01643

BEHAVIOR OF NONCONSERVATIVE POLLUTANTS IN AQUEOUS ENVIRONMENTS,
Washington Univ., St. Louis, Mo. School of Engineering.
Ervin Y. Rodin.
J Water Pollut Contr Federation, Vol 41, No 11, Part 2, p R475-R481, Nov 1969. 7 p, 2 fig, 6 ref.

Descriptors: Water pollution effects, *Great Lakes, *Biodegration, *Reviews, Oxidation, Path of pollutants, Eutrophication, Mathematical models, Nutrients, *Water pollution sources.
Identifiers: Nonconservative pollutants.

A qualitative theory for the description of pollution concentration, buildup, and recovery levels is developed. Pollutants of a nonconservative type (i.e., organic matter, phosphates, etc.) are considered, and the Great Lakes are studied. Rainey's formulations are discussed and evaluated. The theoretical approach presented has the advantage over other methods because it is able to uncover the guiding principles of the process and because it can define effective pollutional levels. (Knapp-USGS)
W70-01688

SYSTEMS ANALYSIS FOR OPTIMAL WATER QUALITY MANAGEMENT,
Federal Water Pollution Control Administration, Edison, N.J.
Ethan T. Smith, and Alvin R. Morris.
J Water Pollut Center Federation, Vol 41, No 9, p 1635-1646, September 1969. 12 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Systems analysis, *Mathematical models, *Optimization, *Water quality control, *Water resources development, Cost allocation, Estuaries, Cost-benefit analysis, Delaware River, Biochemical oxygen demand, Dissolved oxygen, Maintenance.
Identifiers: Uniform treatment.

A comprehensive study of the Delaware Estuary was undertaken in 1961 with the following objectives: (a) to develop methods of water quality management, (b) to determine the cause and effect relationship between pollution from any source and the deteriorated quality of water in the estuary and (c) to prepare a program for the improvement and maintenance of the water quality in the estuary was developed which embodied the cause and effect relationships and control programs based on cost allocation, cost minimization and zoned-optimization models. The optimization model of the estuary was formulated as a combination of the uniform treatment and the cost minimization programs. One of the most significant cause and effect relationships evaluated was that between biochemical oxygen demand and dissolved oxygen. For any given objective set the cost minimization model yielded the smallest cost and uniform treatment model yielded the largest. Certain monetary benefits could be derived from increased use of the estuary once its water quality was improved. (Thiuri-Cornell)
W70-01766

STOCHASTIC MODELS FOR BIOCHEMICAL OXYGEN DEMAND AND DISSOLVED OXYGEN IN ESTUARIES,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
Stephen W. Custer, and Richard G. Krutchkoff.
Water Resources Center, Virginia Polytech Inst, Bull 22, February 1969. 232 p, 41 fig, 8 tab, 64 ref, 3 append. FWPCA Grant WP-01216 under FWPCA Program 16090. OWRR Project A-027-VA. Available from the Clearinghouse as PB 188 094 $3.00 in paper copy, $0.65 in microfiche.

Descriptors: *Stochastic processes, *Biochemical oxygen demand, *Dissolved oxygen, *Estuaries, *Numerical analysis, Diffusion, Computer programs, Decision making, Dispersion, Downstream, Water quality.
Identifiers: Traumatic peaks.

Two distinct stochastic models, the Non-Dispersion Model and the Diffusion Model were developed for determining the biochemical oxygen demand (BOD) and dissolved oxygen (DO) probability distribution in an estuary. The mean BOD and DO concentrations were functions of time and space, hence the probability distributions were also temporally and spatially dependent. A computer program was employed to summarize the results in a concise form so that it could be used in the overall decision process. Information for a given point in space was obtained five miles downstream from the source. The mean BOD and DO levels were obtained for each increment of the tidal cycle. The frequency of the concentration above each critical value was obtained. A comparison of the numerical results revealed that the traumatic peaks observed for the non-dispersion model were obliterated in the diffusion model. In the light of the numerical results it concluded that the non-diffusion model was inadequate for describing the astuary situation. The diffusion model was verified on water quality survey data for the Potomac estuary. (Thiuri-Cornell)
W70-01774

GENERALIZED INITIAL CONDITIONS FOR THE STOCHASTIC MODEL FOR POLLUTION AND DISSOLVED OXYGEN IN STREAMS,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
Richard H. Moushegian, and Richard G. Krutchkoff.
Water Resources Res Center, Virginia Polytech Inst, Bull 28, p 1-88, August 1969. 88 p, 6 fig, 17 tech, 7 ref, 3 append. NIH Training Grant ES-00033-06; FWPCA Research Grant WP-01216-01 for Program 16090. OWRR Project A-027-VA. Available from the Clearinghouse as PB 188 095 $3.00 in paper copy, $0.65 in microfiche.

Descriptors: *Stochastic processes, *Dissolved oxygen, *Biochemical oxygen demand, *Pollutant identification, *Streamflow, Computer programs, Density stratification, Parametric hydrology, Distribution patterns, Water quality, Probability, Standards.
Identifiers: Initial conditions.

A stochastic model was developed and used to predict the biochemical oxygen demand (BOD) and dissolved oxygen (DO) concentrations at several points downstream of a waste discharge. The model used provided a joint density function for both pollution and dissolved oxygen with given initial conditions. The initial conditions were generalized to permit the output for one stream segment to be the initial conditions for the succeeding stream segment. Interest was focused on the measurement of the marginal distribution of BOD and DO along a stream stretch whose parameters may change at known locations. A computer program assisted in the calculations to obtain marginal distributions. The program allowed for changes in parameter values between one stream segment and the next and could predict distributions for any intermediate locations along the river. The application of this study lay in the analysis of an entire stream stretch to determine if it was healthy for the users within certain preset probabilistic standards. (Thiuri-Cornell)
W70-01775

THE BIOLOGICAL EFFECTS OF OIL POLLUTION ON LITTORAL COMMUNITIES. PROCEEDINGS OF A SYMPOSIUM, ORIELTON FIELD CENTRE, PEMBROKE, WALES, 17-19, February, 1968.
For primary bibliographic entry see Field 05C.
W70-01776

WATER POLLUTION IN ALASKA: PRESENT AND FUTURE,
Federal Water Pollution Control Administration, College, Alaska, Water Lab.
Frederick B. Lotspeich.
Science, Vol 166, No 3910, p 1239-1245, Dec 1969. 7 p, 6 fig, 19 ref.

Descriptors: *Alaska, *Water pollution, *Ecology, *Permafrost, *Reviews, Surveys, Environment, Waste disposal, Climates, Fisheries, Water pollution sources.
Identifiers: Industrial development effects (Ecological).

Alaska is on the threshold of economic expansion. The magnitude of the expansion is unknown, but any expansion is certain to increase pollution pressures. Because Alaskan waters are, for the most part, still clean, a unique opportunity exists to apply a preventive program based on ecosystem dynamics, instead of the classical practice of cleanup after deterioration has set in. Research on the tundra and taiga ecosystems must be initiated to learn the dynamics of ecological response to man's quest for new resource development. Alaska's ecology, industry, present state of pollution, and the ecological effects of past industrial activity are briefly reviewed. The problems of the industrial use of permafrost areas are given special attention because of the North Slope oil development. (Knapp-USGS)
W70-01879

GENERALIZED DISTRIBUTION AND CONCENTRATION OF ORTHOPHOSPHATE IN FLORIDA STREAMS,
Geological Survey, Washington, D.C.
Matthew I. Kaufman.
Florida Dep Natur Resources, Bur Geol Map Ser No 33, Aug 1969. 1 sheet, text, 7 fig, 1 tab, 1 map, 9 ref.

Descriptors: *Water pollution sources, *Phosphates, *Florida, Industrial wastes, Municipal wastes, Farm wastes, Runoff, Leaching, Regional analysis, Fertilizers, Chemical wastes, Nutrients, Solutes, Streamflow, Distribution patterns, Mapping.
Identifiers: Orthophosphates.

The distribution and concentration of orthophosphate in Florida streams are described and shown by maps and graphs. In Florida, phosphate sources include industrial wastes, sewage effluent, agricultural drainage, urban drainage, runoff from land naturally rich in phosphates, and rainfall. The greatest contribution is manmade. (Knapp-USGS)
W70-01882

THE INFILTRATION OF ALDRIN THROUGH OTTAWA SAND COLUMNS,
Geological Survey, Idaho Falls, Idaho.
John B. Robertson, and Lloyd Kahn.
In: Geol Surv Res 1969, Prof Pap 650-C, p C219-C223, 1969. 5 p, 3 fig, 1 tab, 17 ref.

Descriptors: *Path of pollutants, *Aldrin, *Groundwater movement, Laboratory tests, Permeameters, Sands, Chlorinated hydrocarbon pesticides, Insecticides, Pesticide residues, Infiltration.
Identifiers: Ottawa sand, Aldrin infiltration.

The penetrability of chlorinated hydrocarbon insecticides through soils is dependent upon the type of formulation applied, frequency of its application, soil conditions, and the frequency and rate of rainfall or irrigation. Aldrin, a representative member of the chlorinated hydrocarbon insecticide group, was infiltrated through columns of Ottawa sand in four experiments. Most of the eluted aldrin in organic solvent systems was eluted during the passage of the first liter of water. The aldrin distributed itself in a characteristic manner through each column, depending upon the composition and stability of the emulsion and rate of water infiltration. The concentration of HHDN (active ingredient in aldrin) in the effluent from the columns reached a 'steady state' condition of 0.5 to 2 micrograms per liter of water. A commercial emulsible concentrate mixture transmitted more aldrin to the effluent than did a synthetic solution containing no emulsifier. (Knapp-USGS)
W70-01904

THERMAL POLLUTION AS A FACTOR IN POWER PLANT SITE SELECTION,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.; and Gurnham, Bramer and Associates.
For primary bibliographic entry see Field 05A.
W70-01923

NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE FEEDLOTS,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
G. L. Hutchinson, and F. G. Viets, Jr.
Science, Vol 166, No 3904, p 514-515, Oct 1969. 1 fig, 1 tab, 6 ref.

Descriptors: *Nitrogen, *Surface water, *Absorption, *Ammonia, Eutrophication, Water pollution sources, Nitrogen compounds, Nutrient cycling, Fertilization, Colorado, Precipitation (Atmospheric), Lakes, Streams.
Identifiers: *Nitrogen pollution, *Cattle feedlots, Seeley Lake (Colo), Nitrogen (Total), Nitrogen (Inorganic), Nitrogen enrichment.

A method is described for estimating nitrogen enrichment of surface waters resulting from volatilization of ammonia from cattle feedlots and its subsequent absorption into lakes and streams. Rates of ammonia absorption into dilute sulfuric acid (0.01 normal) measured near feedlots were as much as 20-fold greater than controls; estimated annual absorption (in kilograms/hectare) of 73 at site about 0.4 kilometers west of 90,000-unit feedlot can be compared with 3.9 at control site with no feedlots or irrigated fields within 3 milometers and no large feedlots or cities within 15 kilometers. Ammonia absorbed by surfaces of natural waters are apparently about half that estimated by method described. That a large feedlot can enhance nitrogen enrichment of aqueous surfaces at some distances is suggested by evidence that a fivefold increase in distance from a feedlot decreased mean ammonia absorption rate by approximately one-half. Absorption rates from smaller lots were approximately 25% of large one, but above fourfold greater than control. Authors believe that wide fluctuations in ammonia absorption rates reflect the moistness of feedlot surfaces, rapid drying enhancing volatilization and absorption. Authors conclude that such feedlots are substantial sources of nitrogen pollution for nearby surface waters. (Eichhorn-Wisconsin)
W70-01936

5C. Effects of Pollution

WATER QUALITY AND AGING OF STRIP-MINE LAKES,
Missouri Univ., Columbia. Dept. of Zoology; and Baylor Univ., Waco, Tex., Dept. of Biology.
Robert S. Campbell, and Owen T. Lind.
J Water Pollut Contr Federation, Vol 41, No 11, Part 1, p 1943-1955, Nov 1969. 13 p, 4 fig, 10 tab, 23 ref. FWPCA Res Grant No WP-00379 Fellowship Award No 2-FL-WP-22892.

Descriptors: *Strip mine lakes, *Acidic water, *Acid mine water, *Water quality, *Lake stages, Biodegradation, Chemical reactions, Water pollution effects, Sulfur bacteria.
Identifiers: Water quality changes.

In many strip-mine lakes the water is at first acidic, but with time becomes less acidic and finally alkaline. Two distinct successional stages are recognized--acid and alkaline--and are identified by different physical, chemical, and biological characteristics. Variation among lakes in the acid stage is dependent on the degree of acid pollution. (Knapp-USGS)
W70-01695

SLUDGE DISPOSAL AND THE MARINE ENVIRONMENT,
Municipality of Metropolitan Seattle, Wash.
For primary bibliographic entry see Field 05E.
W70-01764

THE BIOLOGICAL EFFECTS OF OIL POLLUTION ON LITTORAL COMMUNITIES. PROCEEDINGS OF A SYMPOSIUM, ORIELTON FIELD CENTRE, PEMBROKE, WALES, 17-19, February, 1968.

London, Field Studies Council, July, 1968. 198 p. Supplement to Vol 2 of Field Studies Council. Edited by J. D. Carthy and Don R. Arthur.

Descriptors: *Oil wastes, *Water pollution effects, *Water pollution sources, *Emulsifiers, *Detergents, *Ecology, *Environmental effects, Toxicity, Plant growth, Animal diseases, Microbiology, Bibliographies, Oily water, Ecosystems.
Identifiers: *Torrey Canyon, BP-1002, Durham coast, *Oil spillage.

The purpose was to assess the problems which are raised by oil pollution of a highly complex ecosystem. Oil, derived as it is by biological action, is a complex of substances whose chemistry is, even today, not fully known. The environment is similarly an interwoven web of factors, whose interactions, even under normal conditions, we are only just beginning to understand. When oil pollutes a balanced natural community, it brings a new unnatural factor to imbalance the environmental scene. Another complex variable is introduced when emulsifiers are used to clean away the oil. This symposium collects together the essential basic information, not only on oil but also on the background from which studies of the environmental effects can be initiated. (See also W70-01777 thru W70-01787).
W70-01776

EXTENT OF DAMAGE TO COASTAL HABITATS DUE TO THE TORREY CANYON INCIDENT,
Furzebrook Research Station, Wareham (England).
D. S. Ranwell.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July, 1968. p 39-47.

Descriptors: *Emulsifiers, *Mortality, *Marine algae, *Marsh plants, *Marine animals, *Oily water, Lichens, Tidal effects, Dispersion, Oil-water interfaces, Persistence, Water pollution treatment, Water pollution effects.
Identifiers: *Torrey Canyon, Susceptibility, Regeneration, Cliff vegetation, Sand dunes.

The full range of oil-contaminated habitats resulting from the Torrey Canyon spill were investigated from the air and ground. Decontamination measures and tidal action effectively cleared most oil from the Cornish coast, although some persisted throughout 1967. Over 1 1/2 million gallons of emulsifiers were used. They rapidly cleared the water surface but they distributed contamination beyond the original contamination area, both in depth in sand and water. Toxic elements in the emulsifiers destroyed some marine flora and fauna. The greatest damage occurred on the rocky shorelines where much oil was stranded. Inter-tidal algae and lichens suffered the most extensively among plants because of a cut-off of light and air. The most toxic fractions of crude oil are volatile and disappear rapidly. Manual removal of oil was much preferred over chemical removal methods, as it did not add to pollution. At least 100 species of algae, lichens, and flowering plants were filled by oil or emulsifier pollution. (See W70-01776). (Sjolseth-Washington)
W70-01777

PROBLEMS IN THE ASSESSMENT OF THE EFFECTS OF POLLUTION ON INSHORE MARINE ECOSYSTEMS DOMINATED BY ATTACHED MACROPHYTES,
Durham Univ. (England). Dept. of Geography.
David J. Bellamy, and Alan Whittick.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July, 1968. p 49-54.

Descriptors: *Phytometers, *Aquatic environment, Water pollution effects, Monitoring, Growth rates, Biological communities, Bioindicators.
Identifiers: *Durham Coast, *Phytosociological systems, *Macrophytic algae, Torrey Canyon, Kelp ecosystem performance, Site comparisons, Long-term pollution, Short-term pollution.

Methods have been developed in inshore marine ecosystems for the study of the effects of long-term pollution and these have been used to ascertain the effects of short-term pollution by reference to a study of the Torrey Canyon mishap. One method utilizes comparison with pre-pollution data. Another method is a contemporary comparison between nearby polluted and unpolluted sites. The data obtained by this method was used in two ways to obtain adequate comparison; (a) comparison of individual performance, and (b) comparison of ecosystem performance and potential. These methods have proved to be somewhat successful, although more data will have to be collected to distinguish pollution effects from variations due to natural environmental conditions. (See W70-01776). (Sjolseth-Washington)
W70-01778

EXPERIMENTS WITH SOME DETERGENTS AND CERTAIN INTERTIDAL ALGAE,
University Coll. of Wales, Aberystwyth. Dept. of Botany.
A. D. Boney.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July, 1968. p 55-72.

Descriptors: *Detergents, *Marine algae, Water pollution effects, Lethal limit, Growth rates, Spores.
Identifiers: *Torrey Canyon, *Detergent concentrations, Survival, Susceptibility, Physiological observations, Chronic exposure, Acute exposure.

The direct effects of detergent application following the Torrey Canyon disaster on seven test species of marine algae were studied. Six detergents were used each at several different concentrations. The receptacle tissues of Ascophyllum nodosum were damaged. Cell damage was extensive in Cladophora rupestris. Bryopsis hypnoides were easily killed. The cept phases of Prasinocladus marinus were destroyed by detergents. Growth and spore production of Acrohaetium infestans were retarded. No immediate cell damage was noticed among Polysiphonia lanosa and Porphyra umbilicalis. Both acute and chronic exposures were utilized. (See W70-01776). (Sjolseth-Washington)
W70-01779

BIOLOGICAL CONSEQUENCES OF OIL POLLUTION AND SHORE CLEANSING,
University Coll. of Swansea (Wales). Dept. of Zoology.
A. Nelson-Smith.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July, 1968. p 73-80.

Descriptors: *Oily water, *Marine algae, *Emulsifiers, Water pollution effects, Mortality, Gastropods, Marine plants, On-site data collections.
Identifiers: *Torrey Canyon, Repopulation, Susceptibility.

The effects of oil spills in different areas were investigated to provide interesting comparisons. Oil spilled into a small cove yielded extensive shore pollution and mortalities. No emulsifiers were used, and in less than a year the animal populations were again normal. Gastropod molluscs appeared to be most seriously affected. Marine algae populations were also reduced. Misuse of emulsifiers embedded the oil more firmly and resulted in increased mortalities. Emulsifiers enable the oil to wet the surfaces of shore organisms and to penetrate their systems and also to spread the oil to previously unreached areas. Time of year of oil spill and mobility of organisms regulate the rate at which the members of the shore community are able to recover from oil pollution. (See W70-01776). (Sjolseth-Washington)
W70-01780

THE TOXICITY OF OIL EMULSIFIERS TO SOME INSHORE FAUNA,
University of Strathclyde, Glasgow, (Scotland). Dept. of Biology.
E. J. Perkins.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July, 1968. p 81-90.

Descriptors: *Emulsifiers, *Lethal limit, *Bioassay, Marine animals, Water pollution effects, Hydrogen-ion concentration.
Identifiers: *Torrey Canyon, BP 1002, Long-term effects, Short-term effects, Recovery, Dose, Inshore fauna.

Determinations of the acute toxicity of several emulsifiers (BP 1002, Basic 'Slickgone' and Petrofina Tarsolvent) were made and based upon the 24-hour TLm. Oil emulsifiers were found to be very toxic to marine animals. BP 1002 was the most toxic emulsifier. The toxicity of the emulsifiers was related to their stability. The more stable, the more toxic. It was pointed out that effects at dose levels much below the median tolerance limits are likely to be significant in the long run. All emulsifiers tested depressed the pH of seawater. Emulsifiers may produce 100 per cent mortality in 96 hours, at concentrations as low as 10 ppm. The TLm was noticed to vary from season to season. (See W70-01776). (Sjolseth-Washington)
W70-01781

OIL, EMULSIFIERS AND COMMERCIAL SHELLFISH,
Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.
A. C. Simpson.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 91-98.

Descriptors: *Emulsifiers, *Crustaceans, *Mollusks, Oily water, Water pollution effects, Taste, Lethal limit.
Identifiers: BP 1002, Relative susceptibilities, Life stage.

There is no evidence that shellfish have ever been killed by oil spilled, although economic loss is realized because the oil makes them unpalatable. Tested the harm that solvent/emulsifiers might do to shellfish if applied directly on the grounds and determined the toxicity of the solvent/emulsifiers in sea water. Found that if the emulsifiers were applied to areas containing shellfish, a proportion would be killed. These chemicals (diluted in the sea) were also toxic to marine animals. The toxicity of BP 1002 was found to decrease rapidly with time, due primarily to evaporation of the solvent. Experiments were undertaken to determine the relative toxicities to mulluscs and crustaceans of 9 solvent/emulsifiers. The young stages of animals were more susceptible to toxic subtances than were adults. Emulsifiers were found to taint the flesh of shellfish, making them unsaleable. (See W70-01776). (Sjolseth-Washington)
W70-01782

OIL POLLUTION AND BIRD POPULATIONS,
Seabird Group.
W. R. P. Bourne.
Biological Effects of Oil Pollution on Littoral Communities, Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 99-121.

Descriptors: *Water birds, *Oily water, Rehabilitation, Fecundity, Water pollution effects, Migratory birds, Migration patterns, Data collections, Mortality.
Identifiers: *Torrey Canyon, Adaptations.

Aquatic birds are particularly susceptible to oil pollution. Since their reproductive capacity is low, the results are devastating. An historical survey of the work conducted on oil pollution and birds is presented. The effect of past oil spills on bird populations is described in detail. Declines of certain bird populations are related to oil pollutions. The composition of the bird-kill in some British oil pollution incidents (e.g., Torrey Canyon) was presented. The main mortality occurs among the young birds. Extreme adaptation to an aquatic environment renders birds susceptible to oil pollution because they are not capable of sustained flight and must often touch the water surface where they are continually exposed to floating oil. Aquatic seabirds have no defenses against oil. Rehabilitation of oil contaminated birds is not very successful. Possible future research is discussed. (See W70-01776). (Sjolseth-Washington)
W70-01783

POST-MORTEM FINDINGS IN OILED AUKS DYING DURING ATTEMPTED REHABILITATION,
Wildfowl Trust, Slimbridge (England).
J. V. Beer.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 123-129.

Descriptors: *Oily water, *Rehabilitation, *Water birds, Water pollution effects, Mortality, Stress, Parasitism, Diseases.
Identifiers: *Post-mortem examination, Torrey Canyon, Auks, Starvation.

Birds suffering from oil pollution occuring after the Torrey Canyon affair were captured and given rehabilitation. The survival of auks during attempted rehabilitation was determined to be low. Mortality during attempted rehabilitation followed an exponential path. Only a small proportion of birds were rehabilitated. The dead birds were given post-mortem examinations. Practically all of the birds which died were emaciated. Respiratory disease, acute enteric conditions, renal diseases, and oil stained plumage were among the most serious conditions. The pattern of mortality and pathological changes were strongly suggestive of severe stress and the presence of powerful irritants of poisons in the gut. (See W70-01776). (Sjolseth-Washington)
W70-01784

EFFECT OF DETERGENTS AND OILS ON THE CELL MEMBRANE,
Chester Beatty Research Inst., London (England).
R. J. Goldacre.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 131-137.

Descriptors: *Emulsifiers, *Biological membranes, *Detergents, Effects of water pollution, Solubility, Chemical properties.
Identifiers: *Paraffin hydrocarbons, *Amoeba proteus, BP 1002, Anionic detergents, Cationic detergents, Non-ionized detergents, Volatility, Narcotic effects.

This paper reports on the effects of various pure substances found in crude oil and in emulsifiers on the plasma membrane of Amoeba proteus. With increasing oil concentrations the Amoeba became anaesthetized, the plasma membrane doubled in area, and the inner surface of the cell membrane peeled off. If the cells were kept in the oil, they died, often accompanied by bursting of the plasma membrane. Paraffin hydrocarbons above C14 were not able to damage the membrane. Involatile and relatively insoluble oils had no effect on Amoeba even in saturated solution. Anionic detergents cause rapid removal of the cell membrane, resulting in bursting of the cell. Cationic detergent caused a toughening of the cell membrane and eventually death. Non-ionized detergents such as BP 1002 used in the Torrey Canyon disaster also left a visible membrane after killing the cells. Author feels that the mechanism with detergents may therefore be adsorption on the membrane of competition for adsorption with an existing membrane component. (See W70-01776). (Sjolseth-Washington)
W70-01785

THE BIOLOGICAL PROBLEMS OF LITTORAL POLLUTION BY OIL AND EMULSIFIERS -- A SUMMING UP,
King's Coll., London (England). Dept. of Zoology.
Don R. Arthur.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 159-164.

Descriptors: *Oily water, *Marine animals, *Mortality, Water pollution treatment, Water pollution effects, Marine plants, Emulsifiers, Detergents, Aquatic environment, Biological communities, Mollusks, Crustaceans, Rehabilitation.
Identifiers: Torrey Canyon, Regeneration, Recovery.

The author reviews the biological problems of Littoral pollution by oil and emulsifiers discussed in the symposium of which this paper is a part. The magnitude of oil pollution and prospects for increased pollution are described. The dangers of pollution are elaborated. The primary causes of death by pollution are reviewed. The need for determining the chronic effects of oil pollution is stated. Nine problems which urgently need the attention of biologists are elaborated. (See W70-01776). (Sjolseth-Washington)
W70-01786

A CLASSIFIED BIBLIOGRAPHY OF OIL POLLUTION,
University Coll. of Swansea (Wales). Dept. of Zoology.
A. Nelson-Smith.
Biological Effects of Oil Pollution on Littoral Communities. Supplement to Volume 2 of Field Studies. London, Field Studies Council, July 1968. p 165-196.

Descriptors: *Water pollution sources, *Bibliographies, *Water pollution effects, *Water pollution treatment, Emulsifiers, Rehabilitation, Mortality, Water birds, Fish, Fishkill, Chemical properties, Physical properties.

This article contains a classified bibliography of oil pollution. The bibliography contains 6 subgroups: (1) General accounts and overall effects of oil pollution incidents. 193 entries; (2) More specific accounts of biological effects of oil pollution. 169 entries; (3) Processes and methods by which split oil is removed. 219 entries; (4) Sources, control and prevention of oil pollution. 157 entries; (5) Physical and chemical properties of hydro carbons influencing their behavior as pollutants. 33 entries; (6) Methods for detection, identification and determination. 68 entries. (See W70-01776). (Sjolseth-Washington)
W70-01787

PHYSIOLOGY OF GRANULAR LEUKOCYTES IN FISH BLOOD,
L. I. Smirnova.
Translation from Voprosy Ikhtiologii. Problems of Ichthyology, Vol 8, No 5, 1968. p 748-755.

Descriptors: *Fish physiology, *Algae, *Thermal pollution, *Toxicity.
Identifiers: *Fish hematology, *Granular leucocytes, *Muscular exertion, *2-methyl-5-vinylpyridine, *Glue green algae, Bream, White bream, Leukocytic composition, Alternating current.

A connection was established between the leucocytic composition of the blood in fed and starving bream. An increase in the number of granulocytes circulating in the blood was observed in some favorable and some stress conditions, such as intensive feeding, temperature increase, increased activity, electrical stimulation and exposure to 2-methyl-5-vinylpyridine, Blue green algae. With the changes in the white blood cell composition, there were parallel reductions in the resistance of red cells and their subsequent destruction. (Katz-Washington)
W70-01788

MORTALITY RATE OF DREISSENA IN ANAEROBIC CONDITIONS,
V. P. Mikheev.

Trans from Trudy Instituta Biologii Vnutrennikh Vod, No 7 (10), 1964. Jerusalem, Israel Program for Scientific Translations, 1968, p 65-68.

Descriptors: *Mollusks, *Oxygen sag, *Anaerobic conditions, *Mortality, Water pollution.
Identifiers: *Dreissena, *Oxygen deficient waters, *Water temperature effects, *Oxygen requirements.

Reported an experiment to determine ability of Dreissena to tolerate reduced oxygen conditions. Dreissena were able to survive in water with D.O less the 0.7 mg/l for several days and some survived for two days in anaerobic water. Survival in the water of reduced D.O was less at higher temperatures. Small mollusks have greater relative oxygen consumption and die sooner than the larger organisms. (Katz-Washington)
W70-01789

EFFECTS OF COBALT CHLORIDE ON PHYSIOLOGICAL INDICES IN RAINBOW TROUT (SALMO IRIDEUS GIBBONS),
Gosudarstvennyi Nauchno-Issledovatelskii Institut Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR).
A. A. Shabalina.
Translation from Voprosy Ikhtiologii, Problems of Ichthyology, Vol 8, No 5, 1968, p 741-747.

Descriptors: *Rainbow trout, *Cobalt, *Toxicity, Water pollution effects, Water temperature.
Identifiers: *Cobalt chloride, *Body fat distribution, Hemoglobin content, Hematological indices, Heat tolerance.

Cobalt chloride was added to the diet of young and two-year old rainbow trout. The tolerance of the young trout to increased water temperatures was not affected, but the tolerance of the two-year olds was increased by 1.6 deg C. Hemoglobin content of the blood was unchanged. The distribution of body fat was changed. In toxic doses cobalt produced gastro-intestinal hemorrhages in both groups of fish. (Katz-Washington)
W70-01790

EFFECTS OF FOREST SPRAYING WITH DDT IN NEW BRUNSWICK ON FOOD OF YOUNG ATLANTIC SALMON,
University of Western Ontario, London. Dept. of Zoology.
Miles H. A. Keenleyside.
Journal of Fisheries Research Board of Canada, 24 (4), 1967, 807-822. 6 fig, 4 tab, 20 ref.

Descriptors: *Atlantic salmon, *DDT, *Fish diets, *Aquatic insects, Spraying, Feeding rates, Forage mixtures, Diptera.
Identifiers: *Stomach contents, Ephemeroptera, Trichoptera, Chironomidae.

Food in stomachs of your Atlantic salmon from the Northwest Miramichi River, N.B., changed following aerial DDT spraying of the surrounding watershed. Before spraying, young salmon typically ate immature aquatic insects, fry (underyearlings) concentrating on Diptera and small Ephemeroptera, and parr (overyearlings) on Diptera, Trichoptera, and all sizes of Ephemeroptera. Reduction of all aquatic insects by DDT was soon followed by resurgence of Chironomidae and other Diptera, and surviving fry fed heavily on these; parr fed on Diptera but also ate snails, worms, and fish, previously unimportant in their diet. Five years after the last spraying the prespray complexity of young salmon food was being approached. Trichoptera were slowest of the major fish-food types to reappear in stomachs. In fry stomachs Ephemeroptera, and in parr stomachs Ephemeroptera and trichoptera, were relatively more abundant than in the surrounding stream fauna. Greater availability of these insects and active selection by fish are discussed as possible causes of these relationships. (Sjolseth-Washington)
W70-01793

PHYSIOLOGICAL TOLERANCES AND BEHAVIOR RESPONSES OF FIVE SPECIES OF HAUSTORIIDAE (AMPHIPODA: CRUSTACEA) TO FIVE ENVIRONMENTAL FACTORS,
Fisheries Research Board of Canada. Marine Ecology Lab.; and Bedford Inst., Dartmouth (Nova Scotia).
D. D. Sameoto.
Journal of Fisheries Research Board of Canada, Vol 26, No 9, 1969, p 2283-2298. 3 fig, 3 tab, 32 ref.

Descriptors: *Amphipoda, *Crustaceans, *Organic matter, *Oxygen requirements, *Particle size, *Salinity, *Temperature, Sediments.
Identifiers: *Desiccation, *Gaustoriidae, Cape Cod.

Five species of haustoriid amphipods from Cape Cod, Massachusetts, differed in their tolerances to high temperature, desiccation, low salinity, and low oxygen concentration and in references for different sediment sizes. Two intertidal species, Haustorius canadensis Bousfield and Neohaustorius biarticulatus Bousfield, survived longer in air at 100% relative humidity and were more resistant to high water temperature than three species that are basically subtidal, Acanthohaustorius millsi Boudfield, Parahaustorius longimerus Boudfield, and Protohaustorius deichmannae Boudfield. All five species preferred sediments of a particular size range, the intertidal species selecting coarser sediments than the subtidal species. The sediment preference shown by the intertidal species could be changed by altering the organic conditions of the sediment by either drying or igniting the sediment. Acanthohaustorius millsi was the species most tolerant to low oxygen concentration and H. canadensis had the lowest oxygen consumption rate of the five species. The ecological significance of these findings is discussed in relation to the distribution of the five species on Cape Cod. (Tyner-Washington)
W70-01794

INFLUENCE OF TEMPERATURE ON GAFFKEMIA, A BACTERIAL DISEASE OF THE LOBSTER HOMARUS AMERICANUS,
Fisheries Research Board of Canada, Halifax (Nova Scotia). Halifax Lab.
James E. Stewart, John W. Cornick, and B. M. Zwicker.
Journal of Fisheries Research Board of Canada, Vol 26, No 9, 1969, p 2503-2510. 4 fig, 2 tab, 9 ref.

Descriptors: *Temperature, *Lobsters, *Infection, *Pathogenic bacteria, Bacteria, Sea water.
Identifiers: *Gaffkemia, Mean time to death, Nova Scotia, Homarus americanus, Gaffkya homari.

The mean time to death for lobsters (Homarus americanus) infected with Gaffkya homari and kept at constant temperatures was 2 days at 20 C, 12 days at 15 C, 28 days at 10 C, 65 days at 7 C, 84 days at 5 C, and 172 days at 3 C. The lobsters were unable to mobilize at any of these temperatures systemic defenses adequate to eliminate the pathogen. No deaths that could be attributed to infection with G. homari occurred during the 250-day trial at 1 C; the pathogen, however, was not eliminated at this temperature but remained in the lobsters at low levels with virulence unchanged and gave rise to a fatal infection when the temperature was increased. Further studies showed that infected lobsters were adversely affected by a relatively rapid increase of 10 degrees C but not by a 5-degree C increase; a relatively rapid decrease of 15 degrees C but not 10 degrees C was adverse. Infected lobsters at 15 C were most sensitive to a 5-degree C decrease around the 12th day of the infection. (Tyner-Washington)
W70-01795

STUDIES ON EFFECTS OF FOREST SPRAYING WITH INSECTICIDES, 1952-63, ON FISH AND AQUATIC INVERTEBRATES IN NEW BRUNSWICK STREAMS: INTRODUCTION AND SUMMARY,
Fisheries Research Board of Canada, St. Andrew (New Brunswick). Biological Station.
C. J. Kerswill.
Journal of Fisheries Research Board of Canada, 24 (4), 1967, p 701-708. 1 fig, 1 tab, 23 ref.

Descriptors: *Spraying, *Insecticides, *DDT, *Aquatic insects, Effects of water pollution, Atlantic salmon, Brook trout, Fish populations, Mortality.
Identifiers: Aquatic invertebrates, Choristoneura fumiferana, Stomach contents.

This introduces a series of papers on fisheries studies associated with operational and experimental forest spraying, mainly with DDT-in-oil insecticide. It outlines: (a) the history of the spray program developed to counteract an outbreak of the spruce budworm (Choristoneura fumiferana) in New Brunswick; (b) administrative arrangements for developing and coordinating a reasonable research and management program concerning the affected fisheries, mainly for Atlantic salmon (Salmo salar); (c) highlights of field and laboratory studies on effects of insecticide sprayings on caged young salmon and trout (Salvelinus fontinalis), on aquatic insect production, on feeding habits of native young salmon, and on population levels of young salmon. (Sjolseth-Washington)
W70-01796

TREATMENT OF SHELL WITH POLYSTREAM TO INCREASE SURVIVAL OF OYSTERS (CRASSOSTREA VIRGINICA) IN VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
Dexter S. Haven, and James P. Whitcomb.
Special Scientific Report No 54, Mar 1969. 6 p, 2 tab, 5 ref.

Descriptors: *Oysters, *Predation, *Virginia, Mollusks, Molluscacides, Pesticides, Snails.
Identifiers: *Drills, *Plystream, Crassostrea virginica, Oyster spat, Urosalpinx cinerea.

Survival of oysters set on shells treated with Polystream was investigated during 1963 and 1964. Treated and control shells were held in wire bags in the high-salinity intertidal seaside area of the Eastern Shore and in the moderate-salinity subtidal areas of the lower James River. Significantly more spat survived on treated shells than on controls. Differences in survival could not be attributed to absence of drill predation on treated shall. (Tyner-Washington)
W70-01797

THE EFFECTS OF pH, TEMPERATURE AND ACTINOMYCIN ON THE SULFHYDRYL GROUPS IN LIVING EMBRYOS OF SEA URCHINS (FRENCH),
McGill Univ., Montreal (Quebec). Dept. of Zoology.
N. Wolfson.
Comptes rendus des seances de la Societe de Biologie, Vol 162, No 1, 1968, p 73-76. 3 tab, 5 ref.

Descriptors: *Embryonic growth stage, *Proteins, *Temperature, Acidity, Alkalinity.
Identifiers: *Actinomycin, *Mercurial, *pH, *Sea urchins, *Sulfhydryl groups, Blastula, Gastrula, Embryo, Paracentrotus lividus.

The amount of organic mercurial which living embryos of sea urchins can bind shows a gradual increase during early development, an increase which is interpreted as a rise in the superficial sulfhydryl groups accessible to the mercurials. Variations of pH and of temperature produce changes in the SH assay which are compatible with the expected influence of these factors on the availability of SH. Embryos blocked in blastula stage by actinomycin show very little decrease in amount of mercurial bound as compared to gastrular controls, indicating that new gastrular proteins contribute little to binding of mercurials. (Tyner-Washington)
W70-01798

WATER POLLUTION IN ALASKA: PRESENT AND FUTURE,
Federal Water Pollution Control Administration, College, Alaska, Water Lab.
For primary bibliographic entry see Field 05B.
W70-01879

THE SURVIVAL OF SALMON (SALMO SALAR L.) AND SEA TROUT (S. TRUTTA L.) IN FRESH AND SALINE WATER AT HIGH TEMPERATURES,
Ministry of Agriculture, Fisheries and Food, London (England).
J. S. Alabaster.
Water Research, Vol 1, p 717-730, Oct 1967. 6 fig, 6 tab, 17 ref.

Descriptors: *Temperature, *Thermal pollution, *Smolt, *Acclimatization, Salmon, Trout, Salinity, Fisheries.
Identifiers: Salmon parr, Trout parr, Ionic balance, Scotland.

The survival of salmon and seatrout smolts, on sudden exposure to increased temperature, has been measured under field and laboratory conditions in both fresh and salt water. Smolts are more sensitive than parr when tested in fresh water, particularly if no special care is taken to acclimate the fish to the test conditions beforehand. Salmon smolts are most sensitive to an increase in temperature when exposed simultaneously to change from fresh to sea water, though the effect is much less even after only 7 hours prior acclimation to sea water; they are most resistant when tested in 30 per cent sea water. The results indicate that, at the beginning of the period of smolt migration, when acclimation temperatures are about 8 deg C, the rise in temperature of cooling water used by power stations (6-9 deg C) is smaller than any change that could kill fish. At the height of the smolt season, with acclimation temperatures of 10-12 deg C, only abnormal increase in temperature such as might be the case with recirculating back to the cooling water intake, if accompanied by a change from fresh to sea water, without prior acclimation will be lethal. (Rietveld-Vanderbilt)
W70-01913

PHYSIOLOGY OF ACCLIMATION TO LOW TEMPERATURE IN POIKILOTHERMS,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
Kandula Pampapathi Rao.
Science, Vol 137, p 682-3, Aug 1962. 1 tab, 9 ref, 2 p.

Descriptors: *Acclimatization, *Cold resistance, Temperature, Mussels, Worms.

The freshwater mussel, Lamellidens marginalis, and the earthworm, Lampito mauritii, were acclimated to temperatures of 29 deg plus or minus 1 deg C and 19 deg C plus or minus 1 deg C for 20 to 30 days. Analysis of blood of mussels drawn from the heart and body fluids from the earthworm revealed an increase in sodium, potassium, and calcium during cold acclimation in both species. Chloride, magnesium, and free amino acids decreased in both species. Increased protein synthesis occurred in both species and neurosecretory cells of the cold acclimated earthworms exhibited increased activity. Addition of cold acclimated worm body fluid stimulated oxygen consumption in tissues of warm acclimated specimens, indicating that a hormonal agent triggers the sequence of biochemical changes. (Speakman-Vanderbilt)
W70-01916

BENEFICIAL USES OF THERMAL DISCHARGE,
New York State Dept. of Commerce, Albany; and State Univ. of New York, Albany. Atmospheric Sciences Research Center.
R. Stewart, and S. Bjornsson.
Summary Report of the Adirondack Conference, Oct 14-17, 1969. 12 p, 2 fig.

Descriptors: Temperature, *Thermal pollution, *Freeze-drying, Cooling towers.
Identifiers: *Space heating.

This article is the summary of the Adirondack conference and deals with present and future uses of hot water and low grade steam. In Iceland geothermal discharges are being used for space heating, processing, industry, swimming pools and other sporting facilities. The Icelandic fish culture designed to raise salmonoids to release-size in eight months instead of the normal growth period of two years, uses the geothermal discharge to maintain the proper temperature range (10-12C). Of greater economic significance is the use of the steam for freeze-drying. A freeze-dried product weighs about 10-30% of its original weight and may be stored for years. To freeze 1 Kg/fish takes 10.5 Kwh so discharge from 1000 Mw plant contains sufficient heat to freeze-dry 200 tons of fish per hour. A 1000 Mw reactor could heat a 500 acre green house farm (effectively horizontal cooling towers) producing $12 million/year in crops. (Upadhyaya-Vanderbilt)
W70-01922

THERMAL REINFORCEMENT AND THERMOREGULATORY BEHAVIOR IN THE GOLDFISH, CARASSIUS AURATUS,
Harvard Univ., Cambridge. Psychological Labs.; and Harvard School of Public Health, Boston, Mass.
Paul N. Rozin, and Jean Mayer.
Science, Vol 134, Sept 1961. 2 p, 2 fig, 5 ref.

Descriptors: *Temperature control, *Training, Fish.
Identifiers: *Goldfish.

This work shows that goldfish can be trained to perform an arbitrary response in order to bring the environmental temperature closer to its preferred temperature, and if they are given an opportunity, they will control their body temperature to a certain extent. Each of seven goldfish was trained to press a lever with its head in order to produce a drop of approximately 0.3 deg C in the environmental temperature. Two procedures were followed in the experimental sessions. In the first the lever was not accessible until the temperature was raised to 38 deg C, just 3 deg C below the lethal temperature. In the second procedure the temperature was raised gradually from the acclimatization value of 23.5 deg C, and the lever was available throughout the test. Under both procedures the fish controlled the temperature at a level between 33.5 and 36.5 deg C, indicating that the goldfish will regulate its body temperature under constant high-temperature stress. (Speakman-Vanderbilt)
W70-01925

DETERMINATION OF THE BIOMASS OF AQUATIC PLANTS USING AN OPTICAL METHOD,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 07B.
W70-01931

AN INVESTIGATION BY RAPID CARBON-14 BIOASSAY OF FACTORS AFFECTING THE CULTURAL EUTROPHICATION OF LAKE TAHOE, CALIFORNIA-NEVADA,
California Univ., Davis. Dept of Zoology; and Engineering-Science Inc., Oakland, Calif.
Charles R. Goldman, and Ralf C. Carter.
Journal Water Pollution Control Federation, Vol 37, No 7, p 1044-1059, 1965. 11 fig, 5 tab, 27 ref.

Descriptors: *Lakes, *Carbon radioisotopes, *Bioassay, *Eutrophication, *California, *Nevada, Limnology, Primary productivity, Chlorophyll, Sampling, Phytoplankton, Radioactivity, Photosynthesis, Chemical analysis, Trace elements, Temperature, Iron, Nutrients, Light penetration, Sewage effluents, Oxygen, Solar radiation, Periphyton, Bacteria, Spectroscopy, Copper, Nitrogen, Phosphorus, Algae, Water pollution effects, Water chemistry.
Identifiers: *Lake Tahoe (Calif-Nev), Transparency, Light measurements, Euphotic zone, Plant carotenoids, Carbon fixation, Pelagic region, Monomictic, Depth effects, Ionic concentration, Seasonal effects.

Attempts were made to determine significant variability in the present fertility of Lake Tahoe, to estimate more precisely the lake's productivity by a more comprehensive sampling program than previously possible, and, with carbon-14 bioassay methods, to determine eutrophication potential of inflow, both natural and that enriched with sewage effluent. The extreme sensitivity of the carbon-14 method provides a means of predicting levels of nutrient addition which might cause objectional eutrophication. Assumption that the physiological condition of plankton is variable in different parts of the lake is supported by results of study. Areal estimates of productivity were determined by integrating photosynthetic curves resulting from consideration of light extinction, variation in temperature, and the distribution of plankton with depth. A secondary sewage effluent, when diluted to 1/3,700 of original strength, stimulates bioactivity in Lake Tahoe sufficiently to produce a 1% decrease in light transmittance within 12 days. Measurements of primary productivity around the lake's margin show that, despite extensive mixing, localized signs of eutrophication are evident. The extreme sensitivity of Lake Tahoe waters to any change in nutrient regime clearly evidences the potential of even treated effluent for speeding eutrophication. (Jones-Wisconsin)
W70-01933

TDE RESIDUES IN CLEAR LAKE ANIMALS,
California State Dept. of Fish and Game, Sacramento. Wildlife Management Branch; and California State Dept. of Public Health, Sacramento. Food and Drug Lab.
Jack D. Linn, and Ronald L. Stanley.
California Fish and Game, Vol 55, No 3, p 164-178, 1969. 1 fig, 13 tab, 5 ref.

Descriptors: *Chlorinated hydrocarbon pesticide, *Pesticide residues, Bass, Bullheads, Gulls, California, Catfishes, Plankton, Sunfishes, Gas chromatography, Water pollution sources, Water pollution effects.
Identifiers: *DDD, *TDE, Black crappie, Goldeneye, Grebe, Merganser, Sacramento perch, Clear Lake (Calif), Tetrachloro-diphenyl-ethane, Dichloro-diphenyl-dichlorethane.

Thirteen collections taken from Clear Lake, California, between 1959 and 1965, comprising eight fish species, four bird species and one plankton sample, were analyzed for TDE (DDD) residues. Colorimetric method (before 1962) and electron capture gas chromatography were used to determine concentrations of pesticide. No well-defined year-to-year trend in residue levels was noted when all samples were examined together. White catfish showed some tendency toward increased residue levels with increasing age, while mean annual TDE residue in largemouth bass (1958 year class) decreased from 23.5 parts/million (ppm) in 1958 to 7 ppm in 1963. Evidence indicates that TDE contamination, originating from three applications for insect control in 1949, 1954 and 1957, is declining. Mean annual levels in white catfish have declined from 85.7 ppm (1958) to 9.6 ppm (1965) and levels in largemouth bass have declined from 40.9 ppm (1958) to 12.2 ppm (1963). Tabular data include results of flesh and fat analyses for all collections and a comparison of data derived by colorimetric and gas chromatographic methods. (Voigtlander-Wisconsin)
W70-01935

NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE FEEDLOTS,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 05B.
W70-01936

AQUATIC WEED CONTROL WITH SODIUM ARSENITE,
Wisconsin State Board of Health, Madison. Committee on Water Pollution.
For primary bibliographic entry see Field 05G.
W70-01939

PROCEEDINGS OF THE CONFERENCE ON CHANGES IN THE BIOTA OF LAKES ERIE AND ONTARIO.
Buffalo Society of Natural Sciences, N.Y.; and State Univ. of New York, Buffalo. Research Foundation.

Bulletin of the Buffalo Society of Natural Sciences, Vol 25, No 1, 1969. 84 p, 19 fig, 2 tab, 141 ref. Sweeney, Robert A (Editor).

Descriptors: *Conferences, *Biota, *Lake Erie, *Lake Ontario, Analytical techniques, New York, Ecology, Great Lakes, Planning, Eutrophication, Plankton, Water pollution effects, Commercial fish, Fish, Lakes, Plants, Benthos.
Identifiers: Buffalo Society of Natural Sciences, State University College at Buffalo, Buffalo (NY), Lower Great Lakes, Game fish, Ecological techniques.

Growing public concern exists regarding changes effected by pollution and cultural eutrophication on the biota of Lakes Erie and Ontario, particularly regarding the decline of commercial and game fishes, the marked increase of less desirable species, and the alteration in quality and quantity of the flora. This publication reports the proceedings of a conference, held on April 16-17, 1968, of a small group of investigators interested in current or planned studies of these lakes. The conference was organized by the Biology Department, State University College at Buffalo and the Buffalo Society of Natural Sciences and supported by the Research Foundation of the State University of New York. Individual contributions, with names of author indicated in parentheses, are: Changes in the biology of the Lower Great Lakes (Charles A Dambach); Plants in Lakes Erie and Ontario, and changes of their numbers and kinds (Charles C Davis); and Changes in the benthos of Lakes Erie and Ontario (Ralph O Brinkhurst). Report includes an introduction, transcription of discussions following individual papers, and a transcription of a discussion by all participants of problems and techniques. (See also W70-01943 thru W70-01945). (Eichhorn-Wisconsin)
W70-01942

CHANGES IN THE BIOLOGY OF THE LOWER GREAT LAKES,
Ohio State Univ., Columbus. Natural Resources Inst.
Charles A. Dambach.
Bulletin of the Buffalo Society of Natural Sciences, Vol 25, No 1, p 1-17, 1969. 19 ref.

Descriptors. *Biology, *Great Lakes, *Lake Erie, *Lake Michigan, *Lake Ontario, Lake Huron, Aesthetics, Ecology, Economics, Ohio, Commercial fishing, Public health, Walleye, Vegetation, Wild rice, Silts, Plankton, Mayflies, Fauna, Fish, Oligochaetes, Midges, Snails, Phosphorus, Nutrients, Algae, Diatoms, Chlorophyta, Dissolved oxygen, Pike, Carp, Drum (Freshwater), Cisco, Lake trout, Eutrophication, Striped bass, Cyanophyta, Water pollution effects, Electric powerplants.
Identifiers: Hexagenia, Chironomidae, Procladius, Chironomus promosus, Trichoptera, Leeches, Fingernail clams, White fish, Alewife, Gizzard shad, Sea lamphrey, Coho salmon.

Dramatic biological changes have appeared in bottom fauna and among certain fishes of the lower Great Lakes. Of special significance is abundant increase, since 1959, of the midge Procladius, a supposedly more pollution-tolerant form, while Chironomus promosus has decreased, suggesting that pollution zones have extended further into the lakes. The mayfly is now rare. Benthic fauna is now dominated by oligochaetes and midges, with some fingernail clams, snails, and leeches on the increase. Chemical conditions probably provide a more reliable index to changes than plankton data, but are difficult to relate. Species composition, once dominated by diatoms, are now dominated by blue-green algae. Decline of certain high quality fishes, notably the blue pike and walleye pike, is largely responsible for the accelerated public interest in corrective measures. Relative significance of environment versus overfishing is debatable. Increase in eutrophication rate of the Great Lakes, especially Lake Erie, is significant. Human technology can so modify the environment that biological populations are significantly affected. Biologists with requisite knowledge, should develop better guidelines for weighing costs of each increment of degradation and each increment of improvement. (See W70-01942). (Jones-Wisconsin)
W70-01943

PLANTS IN LAKES ERIE AND ONTARIO, AND CHANGES OF THEIR NUMBERS AND KINDS,
Memorial Univ. of Newfoundland, St. Johns. Dept. of Biology.
Charles C. Davis.
Bulletin of the Buffalo Society of Natural Sciences, Vol 25, No 1, p 18-44, 1969. 8 fig, 2 tab, 100 ref.

Descriptors: *Lake Erie, *Lake Ontario, *Plants, Phytoplankton, Benthic fauna, Benthic flora, Diatoms, Nannoplankton, Ecology, Climates, Weather modification, Depth, Eutrophication, Glaciation, Water levels, Storms, Seiches, Solar radiation, Rainfall, Runoff, Winds, Carp, Muskrats, Turbidity, Cyanophyta, Chlorophyta, Ecosystems, Molds, Management, Periphyton, Yeasts, Fish, Water pollution effects.
Identifiers: Upwarping, Cladophora fracta, Asterionella, Synedra, Melosira, Cyclotella, Fragilaria, Stephanodiscus, Pediastrum, Anabaena, Oscillatoria, Seasonal pulses, Tectonic changes, Phycomycetes, Phytogeography.

The literature regarding vegetational changes in Lakes Erie and Ontario is reviewed. Most studies dealing with periphyton have been taxonomic; studies of macrophytobenthos, more extensive, though usually lacking in continuity, make effective comparisons with past conditions difficult. With glacial recession and land rebounding, changes in water depth are probably too gradual to cause the observed gross vegetational changes; long-range climatic changes are also likely to have been too slow for great effects in the period observed. Occurrence of heavy storms, seiches, fluctuations of sunshine and precipitation, and other short-range weather variables affect aquatic vegetation. Direct or indirect effects upon benthic plants through human activities (introducing foreign fish species and other organisms) have been observed. Summaries of phytoplankton studies indicate that very few offer detailed, reliable conclusions concerning plant community changes over the years. Long-range changes in dominant phytoplankters were demonstrated. There is evidence of rapid artificial eutrophication of Lake Erie. In both lakes, further quantitative seasonal studies of phytoplankton are needed. Phytogeographic problems are important. More is learned regarding water masses by examining planktonic biota than by sensitive chemical and physical measurements. Ecosystems must be clearly understood if they are to be intelligently managed for long-range benefits of mankind. (See W70-01942). (Jones-Wisconsin)
W70-01944

CHANGES IN THE BENTHOS OF LAKES ERIE AND ONTARIO,
Toronto Univ. (Ontario). Dept. of Zoology.
Ralph O. Brinkhurst.
Bulletin of the Buffalo Society of Natural Sciences, Vol 25, No 1, p 45-71, 1969. 11 fig, 21 ref.

Descriptors: *Lake Erie, *Lake Ontario, *Benthos, Oxygen, Eutrophication, Oligotrophy, Fish, Temperature, Pollution abatement, Mayflies, Oligochaetes, Tubificids, Currents (Water), Depth, Sodium, Sampling, Great Lakes region, Water pollution effects, Bioindicators.
Identifiers: *Biotic changes, Pontoporeia, Hyalella, Sphaeriid mollusks, Chironomids, Lumbriculidae, Pisidium forms.

Species composition of chironomid and oligochaete fauna in deepest parts of Lakes Erie and Ontario and Georgian Bay is fairly consistent with Beeton's trophic classification of these three lakes. The bottom fauna of Lake Erie suggests a west to east gradient from extremely eutrophic to moderately oligotrophic conditions. A similar south to north gradient is, at least partly, a reflection of temperature. Lake Ontario fauna suggests oligotrophy with possibly an eutrophic shore zone. Oxygen determinations of 10 years ago would be valuable. In grossly polluted situations, numbers of oligochaetes stay high; representatives of other groups may be scarce. Commonest oligochaete under such conditions is Limnodrilus hoffmeisteri. Proportion of oligochaetes to other forms of life, and the percentage of Limnodrilus hoffmeisteri in relation to all oligochaetes may be guides to degree of organic pollution. Difficulties in discussing the chironomid fauna include problems of nomenclature and systematics. The bottom fauna, potentially a good indicator of qualitative change, has been studied only superficially in the past. Since hard parts of chironomid larvae preserve well in lake sediments, core analyses might provide information on whether the distributions represent recent developments. (See W70-01942). (Jones-Wisconsin)
W70-01945

STUDIES OF THE PHYSIOLOGY AND ECOLOGY OF SPHAEROTILUS NATANS,
Oregon Agricultural Experiment Station, Corvallis.
H. K. Phinney, C. D. McIntire, W. H. Reese, J. M. Robertson, and C. E. Warren.
Terminal Report, Submitted to the Northwest Pulp and Paper Association, Mar 1, 1967. 31 p 16 tab, 4 fig, 4 ref.

Descriptors: *Sphaerotilus, *Sewage bacteria, *Water temperature, *Hydrogen ion concentration, *Nutrients, *Periphyton, *Ecology.
Identifiers: *Cell morphology, *Metabolic pathways, *Temperature and growth, *pH and respiration, *Nutrition of Sphaerotilus Laboratory communities, Isolation techniques, Culture techniques, Field methods.

Studies on the morphology, physiology and ecology of Sphaerotilus in the Laboratory and artificial streams were conducted. Amount of sheath material enclosing cells varied inversely with the amount of peptic and casamino acids in the culture medium. In pure culture Sphaerotilus grew at temperature of 3 to 35C and in the stream at 2C. Maximum rate of respiration at a pH of 7.5; no oxygen consumption at pH 6.0 and 5.7. Growth characteristics in a stream were observed and the population size depended on the supply of sucrose and urea. Diversity of other organisms was greater in areas of stream with little Sphaerotilus. Biomass of snails was greater; benthic insects were more abundant and trout production was greater in sections of the stream where Sphaerotilus was abundant. (Katz-Washington)
W70-01994

THE ACUTE TOXICITY OF SOME HEAVY METALS TO DIFFERENT SPECIES OF AQUATIC INSECTS,
National Water Quality Lab., Duluth, Minn.
STEPHEN L. Warnick, and H. L. Bell.
Journal Water Pollution Control Federation, Vol 41, No. 2, Part 1, p 280-284, Feb 1969. 3 tab, 12 ref.

Descriptors: *Copper, *Metals, *Aquatic insects, *Toxicity, Mayflies, Caddisflies, Fish food organisms, Bioassays.
Identifiers: *Iron salts, *Zu salts, *Cadmium salts, *Lead salts, *Copper salts, *Nickel salts, *Cobalt salts *Chromium salts, *Mercury salts, Stoneflies.

In static bioassays the acute toxicity of Cu, Zn, Cd, Pb, Cr, Hg, Co, Ni, and Fe salts on three species of stoneflies, mayflies and caddisflies was determined. The median tolerance limits of the metal salts for these organisms was determined. The mayfly was the most sensitive of the insects tested to all of the metals used. Insects seemed to be more tolerant than many species of fish. In the experimental procedures used, the 02, pH, and hardness remained fairly constant and these factors did not seem to influence mortalities. (Katz-Washington)
W70-01995

THE TOXICITY OF ENDRIN-RESISTANT MOSQUITOFISH TO ELEVEN SPECIES OF VERTEBRATES,
Mississippi State Univ., State College. Dept. of Zoology.
Peter Rosato, and Denzel E. Ferguson.
BioScience, Vol 18, No 8, p 783-784, Aug 1968. 1 tab, 4 ref. USPHS Grant No, UI 00348-01.

Descriptors: *Endrin, *Resistance, *Pesticide toxicity, DDT, Pesticides, Prey fish, Predation, Pesticide residues.
Identifiers: *Mosquitofish.

Mosquitofish and 5 additional species of fish were found resistant to a variety of chlorinated hydrocarbon insecticides. This study demonstrates the potential hazard of endrin-exposed resistant mosquitofish to eleven species of vertebrates. Resistant mosquitofish containing an average of 890.02 ppm of endrin were force-fed to redfin, pickerel, largemouth bass, bluegills, bullfrogs, redeared turtles, water snakes (several species), purple grackles, starlings, and quail. Controls, two of each species tested, were fed endrin-susceptible mosquitofish containing no pesticides. All controls survived and exhibited no symptoms of discomfort. Approximately 95% of the eleven species tested died from eating one endrin-treated fish. Findings show that resistant mosquitofish tolerate endrin residues sufficient to kill predators several hundred times their own weight. (Sjolseth-Washington)
W70-01996

EFFECTS OF FOREST SPRAYING WITH DDT ON AQUATIC INSECTS OF SALMON STREAMS IN NEW BRUNSWICK,
Toronto Univ. (Ontario). Dept. of Zoology.
F. P. Ide.
J Fish Res Bd, Canada, Vol 24 (4), p 769-805, 1967. 12 fig, 22 ref, 6 append.

Descriptors: *DDT, *Aquatic insects, Fish food organisms, Mayflies, Stonflies, Caddisflies, Pesticide toxicity.
Identifiers: *Salmon populations, Forest spraying, Spruce budworm, Miramichi river, Insect drift collections, Daily insect emergence, Recover, Bottom fauna.

Sampling of emerging aquatic insects by cage-traps on a 24-hr basis showed the effects on the stream fauna of spraying forests with DDT at 1/2 lb/acre in June. Except for a few individuals that presumably emerged from unaffected pupae and nymphs, there was an interval of several weeks after spraying when no emergency occurred. From about the middle of August, however, large populations of very small insects, mainly chironomids, emerged in the spray year. The year after spraying, as compared with the spray year, there was an increased variety including some larger species. In following years there was further recovery by increase in larger forms through reproduction from residual small populations. From the standpoint of feeding of the young salmon, significant facts are: (a) the severe reduction in the bottom fauna of larvae and nymphs of all sizes in the first weeks after spraying; (b) the large populations of small larvae, mainly chironomids, developing in late summer of the spray year and so available to fry; (c) increasing numbers of larger insects the year after spraying and subsequent years. (Sjolseth-Washington)
W70-01999

TOXICITIES OF FOUR INSECTICIDES TO RESISTANT AND SUSCEPTIBLE MOSQUITOFISH IN STATIC AND FLOWING SOLUTIONS,
Mississippi State Univ., State College. Dept. of Zoology.
W. David Burke, and Denzel E. Ferguson.
Mosquito News, Vol 29, No 1, p 96-101, Mar 1969. 2 fig, 12 ref. Grants ES 00086 and UI 00348 from U.S. PHS.

Descriptors: *Pesticide toxicity, Bioassay, DDR, Endrin, Resistance, Fishkill, Insecticides.
Identifiers: *Static tests, *Flowing tests, Mosquito fish, Toxaphene, Parathion, Population susceptibility.

The toxicity of parathion, toxaphene, DDT, and endrin in static and flowing test solutions to resistant and susceptible strains of mosquitofish was determined. Mortality-concentration curves and time-mortality curves were constructed. In both static and flowing tests, mortality was greater in susceptible fishes than in resistant fishes. The toxicity of a given concentration of DDT, toxaphene, and endrin is greater in flowing solutions than in static solutions. Parathion does not produce the same mortality pattern in resistant fish as do DDT, endrin and toxaphene. This is thought to result from the generation of a metabolite more toxic than parathion itself. This metabolite may be removed from the flowing system at a rate to preclude its buildup to toxic levels. The authors discuss the merits of static and flowing tests. (Sjolseth-Washington)
W70-02000

EFFECTS ON AQUATIC INSECTS OF FOREST SPRAYING WITH PHOSPHAMIDON IN NEW BRUNSWICK,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
C. D. Grant.
J Fish Res Bd Canada, Vol 24 (4), p 823-832, 1967. 9 fig, 2 tab, 5 ref.

Descriptors: *Aquatic insects, DDT, Diptera, Bottom sediments, Aquatic Populations, Pesticide toxicity.
Identifiers: *Phosphamidon, Aerial spraying, Spruce budworm, Emergence pattern, Insect drift collections.

No harmful effects on aquatic insects were detected in two New Brunswick streams after forest spraying with phosphamidon (1/2 - 1 lb/acre) in 1962 and 1963. Comparison of one pre-spray and two post-spray series of bottom samples showed no reduction in number or orders (and families in the case of Diptera) and no abnormal decline in the number of individuals. In numbers and variety of insects emerging daily into stream cages and of insects drifting onto vertical screens in the streams, no charges were attributable to phosphamidon. (Sjolseth-Washington)
W70-02001

SOME ENDRIN RELATIONSHIPS IN RESISTANT AND SUSCEPTIBLE POPULATIONS OF GOLDEN SHINERS, NOTEMIGONUS CRYSOLEUCAS,
Mississippi State Univ., State College. Dept. of Zoology.
J. Larry Ludke, Denzel E. Ferguson, and W. David Burke.
American Fish Soc Trans, Vol 97 (3), p 260-263, July 1968. 3 tab, 1 fig, 10 ref.

Descriptors: *Endrin, *Pesticide toxicity, Pesticide residues, Shiners, Resistance, Bioassay.
Identifiers: Endrin resistance, Resistant Populations Susceptible Populations.

A 1000 ppb endrin solution killed 50 susceptible golden shiners in 75 minutes but only 40 of 50 resistant shiners in 40 hr. Endrin residues in whole bodies of resistant shiners killed in endrin were as much as 82 times those of susceptible shiners. The endrin concentrations in the blood of living resistant shiners were as much as 64 times greater than those of endrin-killed susceptible shiners. We conclude that the use of a critical concentration in the blood for diagnosis of endrin-caused mortality must be based on the tolerances of local populations and may be invalid when applied to an entire species containing resistant populations. (Sjolseth-Washington)
W70-02003

BIOLOGICAL EFFECTS OF OIL POLLUTION - BIBLIOGRAPHY, A COLLECTION OF REFERENCES CONCERNING THE EFFECTS OF OIL ON BIOLOGICAL SYSTEMS,
Federal Water Pollution Control Administration, Edison, N.J. Water Quality Lab.
Donna R. Radcliffe, and Thomas A. Murphy.
Available from Clearinghouse as PB-188 206 $3.00 in paper copy, 0.65 in microfiche. FWPCA Water Pollution Control Series, DAST-19, Oct 1969. 46 p, 500 ref. FWPCA Program Number 15080 FHU 10/69.

Descriptors: Aquatic animals, Aquatic plants, *Bibliographies, Biodegradation, Birds, *Environmental effects, Marine animals, Marine plants, *Oil, *Water pollution effects, Oily water, Oil-water interfaces.
Identifiers: Oil spillage.

References on the biological effects of oil are listed according to the following categories: Publications on the General Aspects of Oil Pollution, Reports of Oil Spill Incidents, General Biological Effects of Oil and of Specific Oil Spill Incidents, Effects of Oil on Birds, Effects of Oil on Fish, Effects of Oil on Shellfish, Effects of Oil on Freshwater Invertebrates, Effects of Oil on Plants, Effects of Oil on Dissolved Oxygen, Carcinogenic Effects of Oil, and Miscellaneous Biological Reports on Oil.
W70-02038

5D. Waste Treatment Processes

PERFORMANCE OF POROUS CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF HARD AND WASTE WATERS,
Ottawa Pollution Control Center (Ontario); and National Research Council of Canada, Ottawa (Ontario). Div. of Applied Chemistry.
Andrew R. Hauck, and S. Sourirajan.
Environ Sci and Technol, Vol 3, No 12, p 1269-1275, Dec 1969. 7 p, 1 fig, 8 tab, 17 ref.

Descriptors: *Water treatment, *Desalination processes, *Water reuse, *Waste water treatment, *Reverse osmosis, Demineralization, Membranes, Membrane processes, Ions, Solutes, Industrial wastes, Reclaimed water, Alkylbenzene sulfonates.
Identifiers: Deionization.

The performance of a few typical Loeb-Sourirajan type porous cellulose acetate membranes is reported for the treatment of hard, polluted, and sewage waters. The membranes used are specified in terms of pure water permeability constant and solute transport parameter for sodium chloride. Using feed waters containing 300- to 800 ppm hardness, product waters containing 2 ppm or less could be obtained with 90% product recovery and an average initial flux of 38 gpd per sq foot at 1000 psig. The possibility of producing 'ultrapure' waters by repeated reverse osmosis processing is indicated. The separation of common pollutants such as nitrates, borates, fluoride, alkyl benzene sulfonate (ABS), ammonia, phosphates, and a few others usually present in plating wastes, and the ap-

plicability of the reverse osmosis process for the treatment of sewage waters and water renovation are illustrated. (Knapp-USGS)
W70-01644

ELECTROSORPTION AND DESORPTION PROCESS FOR DEMINERALIZATION,
Southern Research Inst., Birmingham, Ala.
For primary bibliographic entry see Field 03A.
W70-01671

FREON-12 HYDRATE DESALTING PROCESS,
Mason-Rust, Lexington, Ky.
For primary bibliographic entry see Field 03A.
W70-01677

FACTORS RESPONSIBLE FOR NON-BIODEGRADABILITY OF INDUSTRIAL WASTES,
Texas A and M Univ., College Station. Dept. of Civil Engineering, and Rice Univ., Houston, Tex.
Robert L. Irvine, and Arthur W. Busch.
J Water Pollut Contr Federation, Vol 41, No 11, Part 2, p R482-R491, Nov 1969. 10 p, 2 fig, 25 ref.

Descriptors: *Biodegradation, *Industrial wastes, *Waste treatment, Water chemistry, Oxidation, Chemical oxygen demand, Biochemical oxygen demand, Biological treatment, Sewage treatment.
Identifiers: Non-biodegradable wastes.

Feedback from biochemistry can allow introduction of innovative concepts in biological waste treatment. The specific problem treated deals with the meaning of 'non-biodegradability' and the possible means of biologically removing 'non-biodegradable' materials. The analysis is divided into three categories: (1) Low molecular weight compounds originally present in the influent stream waste. (2) Intermediates and end-products of biological activity found in the effluent waste stream. (3) High molecular weight compounds. After each analysis, a brief discussion indicates how these concepts may be used to develop new treatment practices. (Knapp-USGS)
W70-01689

SODIUM ADSORPTION RATIO INFLUENCE ON STABILIZATION POND SEALING,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering, and South Dakota State Univ., Brookings. Dept of Civil Engineering.
Floyd L. Matthew, and Leland L. Harms.
J Water Pollut Contr Federation, Vol 41, No 11, Part 2, p R383-R391, Nov 1969. 9 p, 4 fig, 3 tab, 9 ref.

Descriptors: *Permeability, *Oxidation lagoons, *Water quality, *Sodium, *Clays, Ion exchange, Clay minerals, Expansive clays, Linings, Seepage, Leakage, Water loss, Soil chemistry.
Identifiers: Sodium absorption ratio.

The different sealing effects of various sodium adsorption ratios, found in natural water supplies, on wastewater stabilization ponds were determined. Ten soil samples were studied and classified. Changes in permeability constants were determined for each sample using waters with sodium adsorption ratios of 0, 10, 40, and 80. The results indicated that the sodium adsorption ratio of the applied wastewater can influence the permeabilities of stabilization pond soils. The normal correlation was one of decreasing permeability as the sodium adsorption ratio was increasing. Greater ion exchange effects were disclosed in soils having lower liquid limits. (Knapp-USGS)
W70-01690

DEGRADATION OF SELECTED CHLORINATED HYDROCARBON INSECTICIDES,
Auburn Univ., Ala. Dept. of Civil Engineering.
Gerald M. Leigh.
J Water Pollut Contr Federation, Vol 41, No 11, Part 2, p R450-R460, Nov 1969. 11 p, 3 fig, 3 tab, 33 ref.

Descriptors: *Biodegradation, *Pesticides, *Chlorinated hydrocarbon pesticides, Gas chromatography, Water pollution treatment, Heptachlor, DDT, Endrin, Path of pollutants, Water chemistry.
Identifiers: Lindane.

The chemical and biological degradation of selected chlorinated hydrocarbon insecticides in aqueous solution was studied by means of electron-capture gas chromatography. Lindane, heptachlor, DDT, and endrin were subjected to the action of the oxidants chlorine, potassium permanganate, and potassium persulfate. None of the oxidants were effective in removing lindane or endrin. Less than 20-percent DDT removals were observed using potassium permanganate or potassium persulfate. Potassium permanganate removed more than 80 percent of the heptachlor in less than 5 hr. Alkaline decomposition of lindane and DDT was observed. Biological studies revealed that lindane is not subject to aerobic biodegradation. Heptachlor decomposes in aqueous solution to 1-hydroxy chlordene and an undetermined compound. Heptachlor removals as large 99.4% were observed to occur within 4 days. (Knapp-USGS)
W70-01696

EVALUATION OF BRINE DESULFATING PROCESS AS APPLIED TO DESALINATION PHASE 1,
Catalytic Construction Co., Philadelphia, Pa.
G. P. Gelblum, W. Pechenick, and C. E. Ennis.
OSW R AND D Progr Rept No 289, Oct 1967. 42 p, 8 tables, 9 fig, 5 ref.
Identifiers: *By-product manufacturing processes, *Economic evaluations, *Feedwater treatment, Capitalized costs, Chemical by-products, Conceptual designs, Design, Flowsheets, Ion exchangers, Removal from feedwater, Sulfate, Scale prevention, Wrightsville Beach plant.

An adaptation of a brine desulfating process originally conceived by the Salt Lake Metallurgy Research Center of the Bureau of Mines was made to treat desalting plant feedwater. Sulfate removal, achieved by treatment with barium resins, was adequate to permit brine temperatures in excess of 350 deg F. By-products in the form of caustic soda, soda ash, and sulfuric acid produce a credit equal to 7 cents/1000 gal of product water from a desalter in the 50-mgd range. Construction and operating costs are detailed.
W70-01722

CALCIUM SULFATE SCALING IN SALINE WATER DISTILLATION,
Monsanto Research Corp., Everett, Mass.
C. H. Lu, and B. M. Fabuss.
Ind Eng Chem Process Design Develop 7, p 206-12, 1968. 7 fig, 4 tab, 31 ref.
Identifiers: *Physical chemistry of scale, *Scaling, Feedwater treatment, Literature surveys, Removal from feedwater, Calcium, Scale prevention, Thermodynamics.

A calculated solubility diagram for calcium sulfate in sea water concentrates is presented. Precipitation limits of calcium sulfate in sea water of different concentrations, determined by heating and evaporation experiments, are given. Great differences in precipitation limits and scale formation were observed in heating (nonboiling heat transfer) and in evaporation (boiling heat transfer) experiments. Effects of the heating surface materials, heating and evaporation rates, residence time, and seeding on the amount of precipitation were very minor. Literature data on scale formation in demonstration plants and pilot plants are presented on the solubility diagram.
W70-01729

ION EXCHANGE PRE-TREATMENT FOR SEA WATER DESALINATION PLANTS,
Maschinenfabrik Augsburg-Nuernberg A.G., Gustavsburg (West Germany).
G. K. Kunz.
Desalination 3, p 363-72, 1967. 24 fig, 1 ref.
Identifiers: *Feedwater treatment, *Ion exchanging, *Physical chemistry of scale, Columns (Process), Distillation processes, Ion exchangers, Scale prevention, Scaling.

A study is made of the dependence of the saturation concentrations of calcium sulphate, anhydrite and hemihydrate modifications on temperatures and concentration factors. The conversion of the hemihydrate phase into the anhydrite phase, whose speed was measured, proved to be of particular importance. Partial softening of seawater by means of ion exchange, using the brine concentrated in the evaporators as a regenerant, reduces calcium ion concentration to such an extent that no deposits occur. Results obtained in discontinuous laboratory experiments show the dependence on the various limiting quantities. The degree of softening can be considerably increased if the ion exchange is carried out continuously, countercurrently. The apparatus used for a typical plant consists of countercurrent columns, the absorption column operating by stages. No pumps are required for the circulation of the resin- regulation is by automatic control of a single valve. The results of the operation of a pilot plant are given with particular reference to the exchange efficiency. The combination with the saturation concentrations of calcium sulphate shows that even with low concentration factors the maximum operating temperatures can be as high as 160 deg C without the solubility limit of the calcium sulphate hemihydrate being exceeded.
W70-01730

POTABLE WATER FROM SEAWATER BY HIGH-TEMPERATURE ELECTRODIALYSIS,
IONICS, Inc., Watertown, Mass.
W. A. McRae.
IN Abundant Nuclear Energy, Proc Symp Gatlinburg, Tenn, Aug 1968. p 269-98, 10 fig, 9 tab, 20 ref. AFC Symp Ser 14 (CONF-680810) 1969.
Identifiers: *Brackish water, *Electrodialysis process, *Water costs estimate, Capitalized costs, Flowsheets, Membrane processes.

Electrodialysis plants which can produce hundreds of millions of gallons daily and which operate at or near ambient temperatures can be installed now. Static tests on membranes at high temperatures show that thermal decomposition of the ion-exchange resin per se will probably not be a serious problem in practical apparatus. The electrical resistances of both membranes and saline water are shown to decrease at a compound rate of about 1%/deg F, and current efficiency is found to be essentially invariant with temperatures. These findings are confirmed by the operation of laboratory electrodialysis apparatus at 180 deg F for up to 4 months at the time this paper was written. Cost are estimated for producing 205 mgd of fresh water from seawater and from brackish water in high-temperature electrodialysis plants integrated with steam-turbine generators. The estimated total cost of producing fresh water from seawater ranges from 44 to 46 cents/1000 gal. Fresh water from 3000 ppm brackish water is estimated to cost 85 cents/1000 gal. Research opportunities are outlined which could reduce the total costs for demineralizing seawater to the range of 20 to 25 cents/1000 gal.
W70-01731

APPLICATION OF LOW-COST ENERGY TO PROCESSING OF SEWAGE WATER FOR REUSE,
Oak Ridge National Lab., Tenn.
I. Spiewak.
IN Abundant Nuclear Energy, Proc Symp Gatlinburg, Tenn, Aug 1968. p 239-47, 5 fig, 3 tab, 2 ref. AEC Symp Ser 14 (CONF-680810) 1969.
Identifiers: *Waste disposal, *Water utilization, Electrodialysis process, Pollution, Wastes.

Water supply and sewerage systems for a city of 2 million are analyzed. Examples are given of a conventional system, a system using advanced waste treatment, and a system using complete wastewater recycle. Low-cost energy has a significant impact only on the water recycle system, which includes a unique desalting process combining electrodialysis and distillation. Waste solids are distilled to dryness. The cost of the total water system ranges from 33 cents/1000 gal for the conventional system to 45 cents/1000 gal for the water recycle system.
W70-01741

OPTIMIZATION OF ACID WASTE SLUDGE CHARACTERISTICS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
J. F. Judkins, Jr. and W. A. Parsons.
J Water Pollut Contr Federation, Vol 41, No 9, p 1625-1634, September 1969. 10 p, 10 fig, 1 tab, 10 ref.

Descriptors: *Optimization, *Acidity, *Waste disposal, *Filtration, *Settling Velocity, Sampling, Design, Sludge treatment, Mixing, Industrial wastes.
Identifiers: Crystal seeding process.

An investigation of the effects of the crystal seeding process on the filterability of lime-sulfuric acid in industrial waste sludges was conducted. The objective of the study was the optimization of the crystal seeding and the provision of information which would be useful for the design of improved processes for the control of water pollution from acid waste charges. Seed dosage, mixing rate, acid concentration and crystal seed age were the variables that were selected for consideration in the investigation. A minimum of three replicate samples were run for individual values of the chosen variables, and the sludge parameters were determined for each sample. Sludge filterability, as measured by specific resistance, and sludge settleability, was determined for each sample. The results implied that crystal seeding could improve the settleability and filterability of sludge formed on lime neutralization of dilute, metal bearing sulfuric acid waste solutions. Optimum values of crystal seed dosage, mixing rate, and acid concentration were formed to be associated with maximum effectiveness of the crystal seeding process. (Thiuri-Cornell)
W70-01763

SLUDGE DISPOSAL AND THE MARINE ENVIRONMENT,
Municipality of Metropolitan Seattle, Wash.
For primary bibliographic entry see Field 05E.
W70-01764

CHEBYSHEV OPTIMAL WASTE DISCHARGES,
Yale Univ., New Haven, Conn. Dept. of Administrative Sciences.
Matthew J. Sobel.
Dept Admin Sci, Rep No 17, Yale Univ, p 1-28, September 1969. 28 p, 8 ref.

Descriptors: *Waste storage, *Optimization, *Water resources, *Water quality control, *Storage capacity, Discharge (Water), Mathematical models, Waste water disposal.
Identifiers: Chebyshev criterion.

The study provided a model for evaluating alternative schedules for storing wastes and discharging stored wastes into a water resource. Equivalently the model related the capacity of the waste storage facility to whatever base level could be ensured for water quality. Two discrete-time deterministic problems were considered (a) for a given storage capacity, what discharge schedule maximized the minimum water quality during a finite horizon (b) for a given minimum water quality during a finite horizon, what was the smallest storage capacity for which there existed a feasible discharge schedule. The Chebyshev criterion was employed to provide optimal solutions to (a) and (b). The criterion was also exploited computationally to obtain exact solutions to (a) and approximate solutions to (b). (Thiuri-Cornell)
W70-01767

OPTIMIZATION OF THE ION FLOTATION OF DICHROMATE,
Kentucky Univ., Lexington; and Tenco Hydro/Aeroscience Inc., Chicago, Ill.
Robert B. Grieves, Gregory A. Ettelt, J. Thomas Schrodt, and Dibakar Bhattacharyya.
ASCE, J Sanit Eng Div, Vol 95, No SA3, p 515-525, June 1969. 11 p, 5 fig, 2 tab, 10 ref, 2 append.

Descriptors: *Optimization, *Ions, *Flotation, *Surfactants, *Volume, Regression analysis, Waste treatment, Chemicals, Cost analysis, Foam fractionation.
Identifiers: Dichromate.

The efficiency of a pilot-plant scale, dissolved-air ion flotation unit for the removal and concentration of dichromate was evaluated. The evaluation was dependent on three variables: the fractional flotation (removal) of dichromate, the enrichment ratio for dichromate, and the fractional flotation (removal) of surfactant. Each dependent variable was related analytically to five independent variables by multiple regression analysis. Optimum values of the independent variables were determined and a chemical cost estimate based on the removal of chromium was carried out. The prime advantage of the ion flotation process was the concentration of the chromium present in the waste (together with the surfactant added) in a small liquid volume of collapsed foam. Chromium was concentrated in a liquid volume less than one per cent of the volume of the waste. (Thiuri-Cornell)
W70-01768

THE BIOLOGICAL EFFECTS OF OIL POLLUTION ON LITTORAL COMMUNITIES. PROCEEDINGS OF A SYMPOSIUM, ORIELTON FIELD CENTRE, PEMBROKE, WALES, 17-19, February, 1968.
For primary bibliographic entry see Field 05C.
W70-01776

RECLAIMING SEWAGE EFFLUENT,
Arizona Univ., Tucson. Water Resources Center.
L. G. Wilson, and G. S. Lehman.
Progressive Agriculture in Arizona, Vol 19, No 4, July-Aug 1967, p 22-24. 2 fig.

Descriptors: *Sewage treatment, *Arizona, *Filtration, *Bermudagrass, *Chemical oxygen demand, Sewage effluents, Tertiary treatment, Waste water treatment, Biochemical oxygen demand, Water quality, Water reuse, Reclaimed water.

The authors report preliminary results of three trials of the effectiveness and durability of grass plot filters for tertiary treatment of municipal sewage effluent under Arizona conditions. It was found that grass height and density should be great enough to ensure true filtration. Bermudagrass can tolerate prolonged flooding with sewage effluent. A substantial part of the effluent percolated downward from the filter plots toward the water table. Therefore, subsurface materials would act as soil filter for part of the effluent. COD (Chemical Oxygen Demand) was found to be a more reliable measure than BOD (Biological Oxygen Demand) in samples containing high algae content. Outlet COD values were consistently lower than inlet values, indicating that the units acted as true filters. (Crouse-Arizona)
W70-01831

COMBINED UNDERFLOW-STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA.
Department of Public Works, Chicago, Ill. Bureau of Engineering.
For primary bibliographic entry see Field 05G.
W70-01869

SECONDARY EFFLUENT DEOXYGENATION AT DIFFERENT TEMPERATURES,
Marquette Univ., Milwaukee, Wis. Dept. of Civil Engineering.
A. E. Zanoni.
Journal Water Pollution Control Federation, Vol 41, No 4, p 640-659, Apr 1969. 11 fig, 2 tab, 23 ref.

Descriptors: *Biochemical oxygen demand, *Nitrification, Temperature, Biological treatment, Sewage effluents, Sewage treatment.
Identifiers: Carbonaceous deoxygenation, Arrhenius expression, Jug dilution technique, Reaction rates.

The effect of temperature on the rate of deoxygenation of raw wastewater has been examined frequently. There is evidence to indicate, however, that secondary effluents do not necessarily behave in a similar manner. In this study, the relationship between temperature and the rate of both the carbonaceous and the nitrogenous deoxygenation of an effluent from a conventional activated sludge wastewater treatment plant is determined. A 'jug' dilution technique was used for the biochemical oxygen demand determinations. Numerous nitrite and nitrate-nitrogen analyses also were conducted to establish the kinetics of the nitrogenous phase of deoxygenation. The resulting data are employed primarily to calculate the temperature coefficient of the modified Arrhenius expression. The dependence of both the first and second stage ultimate demands on temperature is investigated. The first-stage rate constant increased 11.5% per C deg from 5 to 10 deg C, 6.9% per C deg from 10 to 26 deg C, and decreased 2.1% per C deg above 26 deg C. The second stage-rate constant increased 9.2% per C deg from 10 to 20 deg C, and decreased 5.5% per C deg from 20 to 30 deg C. The ultimate demands did not vary significantly with temperature. The nitrification lag time was a strong function of temperature, being 4 days at 30 deg C and 16 days at 10 deg C. (Rietveld-Vanderbilt)
W70-01921

WASTE WATER DEOXYGENATION AT DIFFERENT TEMPERATURES,
Marquette Univ., Milwaukee, Wis. Dept. of Civil Engineering.
A. E. Zanoni.
Water Research, Vol 1, p 543-566, Aug-Sept, 1967. 13 fig, 2 tab, 34 ref.

Descriptors: *Biochemical oxygen demand, *Sewage, *Temperature.
Identifiers: Deoxygenation constants, Deoxygenation activity, Dilution technique, First stage velocity constant, Ultimate oxygen demand, Arrhenius expression, Second order reaction rate equation.

A large number of biochemical oxygen demands (BOD) determinations were conducted on a raw municipal sewage using the dilution technique and at incubation temperatures ranging from 2 to 40 deg C. At incubation temperatures of 20 deg C and above, BOD determinations were conducted at one-sixth, one-third, one-half, 1, 3, 5, and 7 days. At lower temperatures, determination under one day were not conducted, though these test runs were extended for much longer periods. The data were used to evaluate the first stage velocity constant, k, and ultimate demand, L, of the first-order deoxygenation expression, and these, in turn, were related to temperature. It was found that k increased by 12.6% per C deg from 2 deg to 15 deg C, by 4.7% per degree from 15 deg to 32 deg C, and decreased by 1.5% per C deg from 32 deg to 40 deg C. The ultimate demand also varied with temperature above 20 deg C. It was also found that the deoxygenation kinetics could be more accurately described by a second order reaction rate equation than by the conventional first order equation. (Rietveld-Vanderbilt)
W70-01927

HIGH-TEMPERATURE DESALINATION PLANTS FOR NUCLEAR POWER STATIONS,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa.
For primary bibliographic entry see Field 03A.
W70-01955

CHARACTERIZATION OF SETTLING TANKS BY EDDY DIFFUSION,
Engineering-Science, Inc., Oakland, Calif. Research and Development Lab.
Hassan M. El-Baroudi.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6618, p 527-544, June 1969. 12 fig, 15 ref.

Descriptors: *Diffusion, *Settling basins, *Sedimentation, Turbulence, Mathematical models, Sanitary engineering, Analysis.
Identifiers: *Turbulent diffusion, Eddy diffusion, Models, Similarity, Hazen number, Camp number.

A model settling basin study is described of eddy diffusion by using radioactive tracers. A derivation is presented of an eddy diffusion equation based on random dispersion (the normal distribution). The inlet structure gives near ideal mixing; therefore, the source is assumed to be an exponentially-decreasing extended source. The calculated and observed concentrations with time are graphically presented. A similarity rule is proposed for modeling settling tanks. The rule uses both Hazen and Camp numbers for the model and the prototype and approaches Reynold's law as the coefficient of eddy diffusion increases. (Ledbetter-Texas)
W70-01970

SULFIDE PRODUCTION IN WASTE STABILIZATION PONDS,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
Earnest F. Gloyna, and Ernesto Espino.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6637, p 607-628, June 1969. 19 fig, 4 tab, 17 ref.

Descriptors: *Sulfides, *Oxidation lagoons, *Design, *Sulfur bacteria, Stabilization, Waste water, Algae, Diffusion, Sulfur.
Identifiers: *Sulfate ion, *Desulfovibrio, Facultative, BOD, Detention time.

The production and release of hydrogen sulfide from waste stabilization ponds and required design modifications, resulting from increased sulfate or hydrogen sulfide content are discussed. A 6-ft deep facultative model pond was operated under seven different operating conditions. The objective of the experiments was to study the relationships between sulfide concentration. (Ledbetter-Texas)
W70-01971

CHEMICAL COAGULATION OF KRAFT MILL WASTEWATER,
California Univ., Berkeley; Mississippi State Univ., State College; and International Paper Co., Mobile, Ala.
E. J. Middlebrooks, W. E. Phillips, Jr., and Frank J. Coogan.
Water and Sewage Works (Industrial Wastes Supplement) Vol 116, No 3, p IW/7-IW/9, Mar 1969. 4 fig, 1 tab, 4 ref.

Descriptors: *Coagulation, *Pulp and paper industry, Pulp wastes.
Identifiers: *Polyelectrolytes, *Aluminum sulfate, Kraft mill wastes, Anionic, Cationic, Nonionic.

The literature of coagulation of paper mill wastes is reviewed, and the results of experiments run on 6 organic polyelectrolytes (DOW) and aluminum sulfate are reported. The percentage COD was reduced an average 54 percentage; suspended solids and color were reduced about 95. The percentage BOD reduction was less than 20. A dosage of about 4 mg/l for polyelectrolyte and about 40 mg/l for alum was sufficient when the pH was optimal. (Ledbetter-Texas)
W70-01972

A CASE OF FILAMENTOUS ACTIVATED SLUDGE,
Instituut voor Gezondheidstechniek TNO, The Hague (Netherlands).
A. Pasveer.
J Water Pollut Contr Federation, Vol 41, No 7, p 1340-1352, July 1969. 10 fig, 2 tab, 13 ref.

Descriptors: *Fungi, *Activated sludge, *E. coli oxidation lagoons, Sphaerotilus, Wastewater treatment, Aeration.
Identifiers: *The Netherlands, *Filamentous growth, Bulking, Ribonucleic acids, Deoxyribonucleic acids.

A case of light sludge in the oxidation ditch of the Sancta Maria hospital in The Netherlands was investigated. To treat the normal domestic wastewater (15 cu m/hr, 500 mg/l BOD) emanating from the hospital, a 450-cu m oxidation ditch had been constructed. During operation a heavy filamentous growth caused bulking and poor operation. Although past research indicated that the bulking organisms might be Sphaerotilus, laboratory tests under conditions simulating those that were felt to exist in the continuous-fed, constantly aerated oxidation ditch indicated that the organism responsible was filamentous-shaped E. coli. The author presents reasons for this assumption and includes microphotographs. Elimination of the filamentous organisms was accomplished by intermittent feeding (60 cu m/hr for 1 hr) followed by 4-hr aeration, 1-hr sedimentation, and then repeating. (Ledbetter-Texas)
W70-01973

BRITISH PRACTICE IN THE TERTIARY TREATMENT OF WASTEWATER,
Watson (J. D. and D. M.), London (England).
H. R. Oakley, and Terence Cripps.
J. Water Pollut Contr Federation, Vol 41, No 1, p 36-50, Jan 1969. 5 fig, 4 tab, 13 ref.

Descriptors: *Tertiary treatment, *Wastewater, *Lagoons, Phosphates, Standards, Filtration, Legislation, Irrigation.
Identifiers: *Microstraining, *British Isles, Rapid sand filtration, Slow sand filtration, Phosphate removal, Nitrogen removal, Pebble bed clarifiers.

British practice is reviewed in the tertiary treatment of wastewater and specific examples are described with particular reference to experience with effluent lagoons at the Rye Meads Works of the Middle Lee Regional Drainage Scheme. A brief historical review serves to indicate the factors which have governed the methods adopted and is followed by a description of current practice in effluent polishing by land irrigation, microstraining, and sand filtration, and effluent lagoons. A critical comparison is made of these methods. The design and performance of the effluent lagoons at the Rye Meads Works is described in some detail and there is discussion of the current investigations on the control of algae in lagoons and receiving streams. (Ledbetter-Texas)
W70-01974

PHOSPHATE REMOVAL BY A LIME-BIOLOGICAL TREATMENT SCHEME,
Kansas State Univ., Manhattan; and Kansas Univ., Lawrence.
Lawrence A. Schmid, and Ross E. McKinney.
J Water Pollut Contr Federation, Vol 41, No 7, p 1259-1276, July 1969. 10 fig, 3 tab, 9 ref.

Descriptors: *Biological treatment, *Phosphorus, *Lime, *Phosphates, Costs, Nutrients, Wastewater treatment.
Identifiers: *Cell synthesis, *Lime regeneration, *Sludge production, pH.

A process (based on laboratory studies) is proposed for the removal of phosphorus from domestic wastewater by lime treatment of effluent by a high-rate, complete mix activated sludge process. This treatment allows for partial removal of the phosphorus by the lime with the activated sludge organisms removing the remaining portion by synthesis into cell mass. The addition of 150 mg/l calcium hydroxide to raw waste-water resulted generally in a pH of 9.5 phosphate removals of 80 percent, BOD removals of 60 percent, and SS removals of 90 percent. The activated sludge process was found to operate satisfactorily on the lime-treated wastewater, and microbial production of carbon dioxide in the activated sludge unit was sufficient to maintain a pH near neutral in the aeration compartment. (Ledbetter-Texas)
W70-01976

PLANNING INDUSTRIAL WASTE TREATMENT,
New York State Department of Health, Albany.
Hayse H. Black.
J Water Pollut Cont Federation, Vol 41, No 7, p 1277-1284, July 1969. 2 ref.

Descriptors: *Permits, *State jurisdiction, *Construction, *Design standards, *Planning, Industrial wastes, Waste water treatment, Sewage treatment, Surveys.
Identifiers: *Construction permits, *State agencies, Process.

Policies followed by the New York State Department of Health are detailed in reviewing applications for permits for the design, construction, and operation of industrial waste treatment works. Subject areas considered are: project delineation, proposed plant and process description, factory operations, development of design criteria, and combined treatment with domestic wastes. Although not all suggestions for investigation will apply to every project, the principles set forth are applicable to the sound engineering design of industrial waste treatment systems. (Ledbetter-Texas)
W70-01977

ADVANCED WASTEWATER CONTROL SYSTEM,
Yeomans Brothers Co., Melrose, Ill.
Edward F. Bradley.
J Water Pollut Cont Federation, Vol 41, No 7, p 1292-1298, July 1969. 3 fig, 2 ref.

Descriptors: *Wastewater, *Lagoons, *Monitoring, *Wastewater treatment, Disinfection, Instrumentation, Ultraviolet radiation.
Identifiers: *Research project, *St. Michaels, Maryland, Effluent shutoff, Continuous monitoring, Automatic monitoring.

Because, from a public health standpoint, the effluent from a normally operated domestic wastewater treatment plant has adverse effects on the receiving water, a new treatment process has been developed which provides for effective pathogen removal and absolute continuous control over the quality of the treatment plant effluent. This treatment is accomplished by controlled flow, continuous automatic equipment monitoring, continuous automatic evaluation of the degree of treatment provided, detection of equipment malfunction, instantaneous notification of authorities, and automatic stoppage of flow to the receiving waters. A research project at St. Michaels, Maryland, is expected to provide sufficient test data to verify the validity of the system under full-scale conditions, and also should demonstrate the usefulness of ultraviolet light as a means of disinfection comparable to present chlorination methods. (Ledbetter-Texas)
W70-01978

STRUCTURAL DETERMINANTS IN THE OXIDATION OF ALIPHATIC COMPOUNDS BY ACTIVATED SLUDGE,
Ohio State Univ., Columbus. Dept. of Microbiology.
George W. Malaney, and Robert M. Gerhold.
J Water Pollut Contr Federation, Vol 41, No 2, Part 2, p R18-R33, Feb 1969. 12 fig, 7 tab, 30 ref.

Descriptors: *Activated sludge, *Amino acids, *Oxidation, Wastewater treatment.
Identifiers: *Aliphatic compounds, *Columbus (Ohio), Nitriles, Amides, Amines, Carboxylic acids.

The abilities are delineated of 3 activated sludges (Columbus, Ohio) to oxidize the following chemical families: saturated monocarboxylic acids; saturated and unsaturated hydroxy and keto dicarboxylic acids; nitriles; amides; amines; and amino acids. They used a Warburg respirometer with chemical concentrations up to 500 mg/l and solids of 2500 mg/l. They found that saturated mono-carboxylic acids were oxidized immediately; unsaturation in long-chain mono-carboxylic acids increases oxidation amenability; most di-carboxylic acids resist oxidation; the cyanide group decreases oxidation; aliphatic amines were toxic; and amino acid oxidation varied greatly. (Ledbetter-Texas)
W70-01979

KINETICS OF SUBSTRATE UPTAKE IN PURE AND MIXED CULTURE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.
R. I. Mateles, and S. K. Chian.
Environ Sci Technol, Vol 3, No 6, p 569-574, June 1969. 13 fig, 21 ref.

Descriptors: *Kinetics, *Activated sludge, *Cultures, Mathematical models, Model studies, Carbon.
Identifiers: *Biokinetics, *Monod equation, *Zero order, Pure culture, Mixed culture, Continuous culture, Glucose, Lactose, Butyrate, Acetate, Steady-state, Residence time, Batch culture.

Laboratory models were used to study the rates of substrate uptake by various microorganism cultures obtained from a local polluted stream. Acetate production amounted to 15 percent of the carbon source used in a glucose-butyrate feed of a culture that was carbon-limited. The growth rate was 1 hr-sups-1 and the dissolved oxygen pressure was 0.1 atm. There have been no previous reports of acetate production by a carbon-limited continuous culture and current theory says t' ere should be none. The experiments indicate that complete analysis of media leaving a continuous culture or activated sludge process is necessary because of the appearance of catabolites in the effluent. Acclimatization should be carried out under flow conditions identical to those for the test. The steady state condition was reached after 10 to 25 residence times rather than the 5 or 6 usually reported. (Ledbetter-Texas)
W70-01980

REMOVAL OF NITROGEN AND PHOSPHORUS FROM WASTE WATER,
Stanford Univ., Calif.
Rolf Eliassen, and George Tchobanoglous.
Environ Sci Technol, Vol 3, No 6, p 536-541, June 1969. 2 tab, 15 ref.

Descriptors: *Nutrients, *Nitrogen, *Phosphorus, Efficiencies, Cost comparisons, Treatment, Biological treatment, Algal control, Ammonia, Ion exchange, Reverse osmosis, Distillation, Electrodialysis, Sorption, Chemical precipitation, Ultimate disposal.
Identifiers: *Nutrient removal, *Eutrophication, Anaerobic denitrification, Land application, Electrochemical treatment, Ammonia stripping, Algae harvesting.

The principal sources of nitrogen and phosphorus in wastewaters are tabulated with the amounts from each source; domestic and agricultural operations are on a par with industrial output for nitrogen discharges, but phosphorus releases by industry are not available. Nitrogen removal may be done by the following processes with removal efficiencies and cost in dollars per million gallons in parentheses: ammonia stripping (80-98, 9-25), anaerobic denitrification (60-95, 25-30), algae harvesting (50-90, 20-35) and conventional biological treatment (30-50, 30-100). A similar list for phosphorus removal follows: modified activated sludge (60-80, 30-100), chemical precipitation (88-95, 10-70), chemical precipitation with filtration (95-98, 70-90), and sorption (90-98, 40-70). In addition, the conventional biological treatment removes 10-30 percent of the phosphorus. A list of the treatment schemes for removal of both nitrogen and phosphorus is the following: ion exchange (80-92, 86-98, 170-300), electrochemical treatment (80-85, 4-8 for power), electrodialysis (30-50, 100-250), reverse osmosis (65-95, 250-400), distillation (90-98, 400-1000), and land application (60-90 phosphorus, 75-150). Ultimate disposal methods may be classified into 4 groups: dumping; subsurface injection; conversion and dumping; and conversion, product recovery, and dumping. (Ledbetter-Texas)
W70-01981

EXPERIENCE IN PROVIDING FOR SAFETY ASPECTS IN TREATMENT PLANT DESIGN,
Black and Veatch, Kansas City, Mo.
Lloyd W. Weller.
J Water Pollut Contr Federation, Vol 11, No 1, p 122-125, Jan 1969. 5 tab, 2 ref.

Descriptors: *Safety, *Accidents, *Design, *Wastewater treatment, Ventilation, Operation and maintenance, Explosions.
Identifiers: *Treatment plant design, Handrails, Kickplates, Toxic gas, Asphyxiation, Fires, Eye baths, Gas masks, Chlorine leak detectors.

Although an organized effort exists to promote safety in wastewater plants, the safety record of the wastewater field indicates there is urgent need for improvement. Designers must review their thinking and their design procedures to make sure that the safety of operating personnel is given prime consideration in the layout and arrangement of wastewater works. A review of two existing plants and their accident records, however, does suggest that most accidents have their cause in something other than a direct physical deficiency. Because the operation of water pollution control facilities makes exacting and varied the demands on the operating personnel, a total-environment approach toward accident prevention in the wastewater treatment facilities must be made. (Ledbetter-Texas)
W70-01983

THE SLUDGE VOLUME INDEX--WHAT IS IT,
Illinois Univ., Urbana; and North Carolina Univ., Chapel Hill.
Richard I. Dick, and P. A. Vesilind.
J Water Pollut Contr Federation, Vol 41, No 7, p 1285-1291, July 1969. 9 fig, 9 ref.

Descriptors: *Sludge, *Wastewater treatment, *Rheology, *Settling velocity, Activated sludge, Testing.
Identifiers: *Sludge volume index (SVI), Control tests, Thickening, Settling characteristics, Compression characteristics.

Although the sludge volume index (SVI) has become the standard measure of the physical properties of activated sludge, it is possible for sludges with identical SVI values to have vastly different physical properties. The SVI value for a sludge is not consistently related to the settling velocity, compression characteristics, suspended solids concentration, or rheological characteristics of the sludge. Futhermore, results of SVI tests are not indicative of settling characteristics in settling basins. The sludge volume index is a convenient control test in the operation of activated sludge plants, but comparisons of SVI values from various plants are not meaningful. The parameter is not suitable for research applications, and cannot be used to predict recycle requirements or mixed liquor suspended solids concentrations in the activated sludge process. It is suggested that alternate, more meaningful measurements of the physical characteristics of activated sludge be used where possible. (Ledbetter-Texas)
W70-01984

MANASSAS, VA., ADDS NUTRIENT REMOVAL TO WASTE TREATMENT,
Federal Water Pollution Control Administration, Cincinnati; Wiley and Wilson; and Prince William County, Va.
M. C. Mulbarger.
Water Wastes Eng, Vol 6, No 4, p 46-48, Apr 1969. 2 fig, 13 ref.

Descriptors: *Nutrients, *Phosphorus, *Nitrogen, Municipal wastes, Pilot plants, Nitrification, Denitrification, Sludge digestion.
Identifiers: *Luxury uptake, Chemical treatment, Experimental operation.

An experimental 1.0 mgd plant has been built at Manassas, Va., to study the removal of nutrients from wastewater while giving the waste stabilization treatment. A 0.2 mgd biological nitrification-denitrification pilot plant for nitrogen removal is located at the same site. The process will permit higher overall removals of phosphorus and nitrogen than coventional treatment and will remove the carbonaceous and solids materials in the usual amounts. The units are designed for flexibility of operation to provide experimental operation. Unconventional features of the plant are that it does not have primary clarification, and it uses two-stage turbine aeration, intermediate solid-liquid separation by flotation, and chemical precipitation of the digester supernatant. The phosphorus removal is to be by metabolic means, luxury uptake by microorganisms. (Ledbetter-Texas)
W70-01985

MODERN MONITORING OF A TREATED INDUSTRIAL EFFLUENT,
Procter and Gamble Co., Cincinnati, Ohio. Ivorydale Technical Center.
R. G. Ostendorf.
J Water Pollut Contr Federation, Vol 41, No 1, p 89-98, Jan 1969. 9 fig, 3 ref.

Descriptors: *Monitoring, *Biochemical oxygen demand, *Dissolved oxygen, *Industrial wastes, Wastewater, Evaporation, Incineration, Filtration, Flotation.
Identifiers: *Total carbon, *Suspended solids, *Susquehanna River, pH, Paper wastes, Screening, Composite sampler.

The wastes monitoring system is described installed by the Charmin Paper Products Company at their waste treatment facility. BOD wastes are evaporated then incinerated and fiber-bearing wastes are treated for suspended solids removal by screening, precoat filters, and dissolved air flotation. The wastes monitoring system used to maintain the DO in the Susquehanna River at the prescribed 5.0 mg/l concentration consists of composite sampler, pH recorder, DO and BOD analysis, and continuously indicating suspended solids and total carbon equipment. The total carbon and suspended solids analyzers are described. (Ledbetter-Texas)
W70-01986

FUNDAMENTALS OF ACTIVATED SLUDGE,
Department of Water Resources, New York. Bureau of Water Pollution Control.
A. H. Chasick.
J Water Pollut Contr Federation, Vol 41, No 7, p 1377-1382, July 1969. 1 tab, 1 ref.

Descriptors: *Activated sludge, *Aeration, *Sludge, *Fundamentals, Design data, Domestic wastes.
Identifiers: *Step aeration, *New York City, Overflow rates, Gravity thickeners, Process air, Excess sludge, Aeration tank loadings, Mixed liquor solids.

The operation fundamentals are discussed of activated sludge plants in the New York City area, treating weak-to-normal domestic wastewater. Overflow rates are 800 gpd/sq ft (32.7 cu m/day/sq

m) for tanks 200 to 300 ft (61 to 92 m) long. Return sludge pumps operate at 25 to 30 percent of wastewater flow. Gravity thickeners with maximum diameter of 70 ft (21.4 m) are used, with a design load maximum of 8 lb/day/sq ft (39 kg/day/sq m), to produce a sludge containing 5 to 6 percent solids. The operational parameter is the process air added to the aeration tanks - two mg/l air is kept at the aerator outlet. Aeration tank loading rates are 0.20 to 0.33 lb/day (0.10 to 0.15 kg/day); mixed liquor solids content varies from 960 to 1600 mg/l (6-hr detention, 100 mg/l primary effluent solids). The typical four-pass step aeration process has aeration tank loadings of 50 to 60 lb BOD/1000 cu ft of aeration tank. Excess sludge, sludge index, and final tank loadings are also discussed. (Ledbetter-Texas)
W70-01987

WATER RECLAMATION AT SOUTH TAHOE,
South Tahoe Public Utility District, South Lake Tahoe, Calif.
Russell Culp.
Water Wastes Eng, Vol 6, No 4, p 36-39, Apr 1969. 5 fig, 4 tab.

Descriptors: *Tertiary treatment, *Reclamation, *Water reuse, Activated sludge, Activated carbon, Biochemical oxygen demand, Chemical oxygen demand, Odor, Coliforms, Phosphorus, Turbidity, Filtration.
Identifiers: *Nitrogen stripping, Suspended solids, Color, Operating data, Sludge incineration, Carbon regeneration.

A 7.5 mgd water reclamation plant which employs advanced wastewater treatment practices has been operating for 9 mos with good results. The water is used for irrigation of alfalfa, other hay, and pasture land. There are plans to use the water for contact sports. The process starts with chlorination for odor control, then continues with a conventional activated sludge treatment with some recirculation of lime sludge for phosphorus removal. The effluent from the conventional treatment receives 5 steps of tertiary treatment: flocculation and coagulation with phosphorus removal (lime), nitrogen stripping, recarbonation, filtration, activated carbon columns, and chlorination. The sludges are incinerated with recovery of lime and carbon dioxide. The plant removes nearly 100 percent of the BOD, COD, suspended solids, color, odor, coliforms and turbidity. The removal of phosphorus is about 94 percent and of nitrogen is greater than 50 percent. The spent carbon is regenerated with a loss of about 5 percent per cycle. The water is lifted 270 ft to a storage tank then about 1500 feet more to Indian Creek Reservoir where it is removed for use. (Ledbetter-Texas)
W70-01988

LABORATORY AND PILOT PLANT STUDIES ON PHOSPHATE REMOVAL FROM INDUSTRIAL WASTEWATER,
Hercules, Inc., Wilmington, Del.
Bruce W. Dickerson, and Philip J. Farrell.
J Water Pollut Contr Federation, Vol 41, No 1, p 56-62, Jan 1969. 2 fig, 7 tab, 5 ref.

Descriptors: *Phosphates, *Lime, *Industrial wastes, Pilot plants, Biochemical oxygen demand, Centrifugation, Dewatering.
Identifiers: *Alum, *Ferric sulfate, Lake Huron (Mich), Soda ash, Suspended solids, pH.

Laboratory and pilot plant tests were made to develop a treatment method for a wheat flour waste stream with 300 to 330 mg/l of phosphates and 5000 mg/l BOD. Lab studies showed that lime removed phosphate more efficiently than alum and ferric sulfate. Pilot plant studies showed that a 5 mg/l phosphate concentration is attainable at controlled pH. Centrifugation achieved 20 to 40% solids and appeared most practical. They did not claim this to be an economical process for phosphates removal. (Ledbetter-Texas)
W70-01989

PRIMARY TREATMENT OF POTATO PROCESSING WASTES WITH BYPRODUCT FEED RECOVERY,
Eimco Corp., Salt Lake City, Utah; and Simplot (J. R.) Co., Caldwell, Idaho.
Lloyd M. Grames, and Ray W. Kueneman.
J Water Pollut Contr Federation, Vol 41, No 7, p 1358-1367, July 1969. 2 fig, 3 tab, 2 ref.

Descriptors: *Foods, *Settling, *Design, Wastewater treatment, Cost Analysis.
Identifiers: *Primary treatment, *Snake River (Ida), Cattle feed, Vacuum filter, Population equivalent, Grease removal.

The results are reported of an investigation by an engineering committee which the Idaho Potato Processors Association formed to look into different methods of primary treatment to solve a pollution problem created by the operation of processing plants along the Snake River, Pilot-plant tests developed a primary treatment scheme including an optional grease-removal unit, potato waste clarifier, and belt-type vacuum filter. The authors report that the approach adopted by the potato processing industry in Idaho for the solution of the problem has been highly successful, that a primary treatment system with high efficiency has been produced; and that the facilities have resulted in the removal of waste from the waters of the state of Idaho equivalent to a population of more than three million. Dewatered sludge is sold profitably as cattle feed. (Ledbetter-Texas)
W70-01990

COMPUTATIONAL ANALYSIS OF TRANSIENT RESPONSE TO QUANTITATIVE SHOCK LOADINGS OF HETEROGENEOUS POPULATIONS IN CONTINUOUS CULTURE,
Oklahoma State Univ., Stillwater. Bioengineering Labs.
F. F. Storer, and A. F. Gaudy, Jr.
Environ Sci Technol, Vol 3, No 2, p 143-149, Feb 1969. 5 fig, 17 ref.

Descriptors: *Activated sludge, *Model studies, *Mathematical models, Carbon, Nutrients, Growth rates, Biological treatment.
Identifiers: *Shock loadings, *Chemostat, Glucose, Carbon source, Monod equation, Substrate, Cell yield, Continuous cultures, Heterogeneous populations, Heterogeneous cultures.

The Monod equation does not accurately predict the transient state biological solids and substrate concentrations subsequent to an increase in inflowing waste concentration. A chemostat was seeded from the primary clarifier of a sewage treatment plant and operated with synthetic medium. Carbon was furnished by glucose and was the growthlimiting nutrient. Shock loadings up to threefold were employed in six runs. The cell yield was calculated as the ration of the instantaneous rate of production of biological solids to the rate of COD utilization rather than the steady state procedure. A hysteresis was noted in the actual plot and the plot from the Monod equation. Future studies could well use a dual approach to mathematical analysis of biological growth of a heterogeneous population of microorganisms in aerobic conditions of transitional loadings. (Ledbetter-Texas)
W70-01991

CORROSION-RESISTANT COATINGS FOR WASTEWATER TREATMENT PLANTS,
Koppers Co., Inc., Pittsburg, Pa. Organic Materials Div.
A. F. Pistor.
Water Wastes Eng, Vol 6, No 5, p 52-53, May 1969. 1 fig, 1 tab.

Descriptors: *Protective coatings, *Paints, *Corrosion control, Epoxy resins, Coal tar coating.
Identifiers: *Corrosion resistance, *Concrete corrosion, Modified alkyds, Epoxy esters, Phenolic resins, Coal tar pitch, Coal tar epoxies, Chlorinated rubber, Vinyls.

Wastewater treatment facilities need to be constructed for corrosion control along with waste stabilization. Many places in waste treatment facilities are conducive to corrosion. Designs and construction can eliminate many of the causes of corrosion but protective coatings are needed on much of the equipment. The protective coating may be applied over a prime coat or the equipment may be sandblasted and coated in the field. The coatings in use include the following: oil modified alkyds, epoxy esters, phenolic resins, epoxy resins, coal tar pitch, coal tar epoxies, chlorinated rubber, and vinyls. The resistance characteristics are classified of these coatings and their application properties are given. (Ledbetter-Texas)
W70-01993

OIL WASTE DISPOSAL FACILITY STUDY, SEATTLE AREA,
Cornell, Howland, Hayes and Merryfield, Seattle, Wash.
William J. Edwards, and Norman C. Ward.
Municipality, Metropolitan Seattle, Engineering Report, Aug 1969. 51 p, 9 fig, 5 tab, 57 ref.

Descriptors: *Oil wastes, *Reclamation, *Treatment facilities, *Water pollution, *Water pollution control, *oily water, Oil, Pollution abatement, Sludge, Settling basins, Landfills, Sludge disposal, Costs, Incineration, Administration, Finance, Separation techniques, Design.
Identifiers: *Seattle, *Illegal dumping, Reuse, Barging wastes, Enforcement.

The engineering report presents the scope of the oil waste disposal problem, solutions thereto, dangers of contamination of underground and surface waters and details of design, operation, administration and finance of a recommended treatment facility for oil wastes. The study, financed by four public agencies in the Seattle area including the State, was initiated as the result of an illegal discharge of oil, in 1967, into the sewer system of the municipality of metropolitan Seattle. Oil wastes generated annually in the Greater Seattle area (Tacoma to Everett) total 9.3 million gallons. Principal sources are automotive, ship and tank cleaning, and industrial. Reclamation and reuse of the oil wastes, when feasible, is cited as the most desirable procedure to prevent pollution. Limitations of current disposal procedure are discussed--including landfilling, barging to sea, incineration and subsurface injection. The basic recommendation is that a local public agency construct and operate a central facility for disposing of oil wastes brought there by anyone. Total annual cost of the facility was estimated to be $105,000. A charge of 3.5 cents per gallon of wastes received is recommended to make the plant self-supporting. The suggested facility, when completed, would be unique. Federal demonstration grant funds are mentioned. Drawings, tables and bibliography are included. (Poertner-Chicago)
W70-02030

MULTISTAGE BIOLOGICAL PROCESSES FOR WASTE TREATMENT,
Deering Milliken Research Corp., Spartansburg, S.C.; and Clemson Univ., S.C., Dept. of Environmental Systems Engineering.
Eugene P. Willimon, Jr., and John F. Andrews.
J Water Pollut Contr Federation, Vol 41, No 1, p 99-112, Jan 1969. 12 fig, 1 tab, 18 ref.

Descriptors: *Anaerobic conditions, *Fermentation, *Anaerobic digestion, Septic tanks, Pilot plants, Microorganisms, Chemical oxygen demand, Phenols.
Identifiers: *Contact stabilization, pH, Volatile suspended solids, Multi-stage treatment, Continuous systems, Biomass, Coke oven wastes, Thiocyanates.

Use of multi-stage systems is examined in biological processes for anaerobic digestion. Exploratory studies on a two-stage anaerobic process involving pH control and limited aeration in the first stage are

presented. Improved chemical oxygen demand reductions were obtained using the two-stage process. The effects of pH, limited aeration, and retention time on product distribution are described. (Ledbetter-Texas)
W70-02042

5E. Ultimate Disposal of Wastes

SLUDGE DISPOSAL AND THE MARINE ENVIRONMENT,
Municipality of Metropolitan Seattle, Wash.
Ralph S. Domenowske, and Robert I. Matsuda.
J Water Pollut Contr Federation, Vol 41, No 9, p 1613-1624, September 1969, 12 p, 10 fig, 6 tab, 18 ref.

Descriptors: *Sludge disposal, *Marine bacteria, *Water quality control, *Waste treatment, *Benthos, Optimization, Biological properties, Biochemical oxygen demand, Computers, Regression analysis, Bacteria.

The study was conducted by the Municipality of Metropolitan Seattle to determine the minimum treatment and disposal costs required to meet the most stringent water quality standards of puget sound. The study also evaluated the biological and physical changes in the water and benthos which might have been the result of effluent or sludge disposal from the West Point treatment plant. Extensive tests and model studies were conducted prior to the construction of the outfall and predictions were made regarding the functionings of the system. One-way analysis of variance tests between station depth and outfall proximity for seven groups of benthic organisms were made. The analysis of variance, linear regression and computer plots of the chemical oxygen demand and bacterological and primary productivity data were collected and used in the biological analysis. Chemical oxygen demand values showed no significant difference in different strata. The bacteria count had decreased since the West Point Plant had gone into operation. (Thiuri-Cornell)
W70-01764

CHEBYSHEV OPTIMAL WASTE DISCHARGES,
Yale Univ., New Haven, Conn. Dept. of Administrative Sciences.
For primary bibliographic entry see Field 05D.
W70-01767

INCINERATION OF GRIT, SCREENINGS, AND SCUM.
Havens and Emerson, Cleveland, Ohio.

Report, Metropolitan Sanitary District, Greater Chicago, Feb 1969. 77 p, 11 tab, 6 fig, 2 append.

Descriptors: *Scum, *Sediments, *Sewage disposal, *Solid wastes, *Waste identification, *Wastewater disposal, *Incineration, Waste disposal, Wastes, Disposal, Costs, Air pollution, Heat balance, Sanitary engineering.
Identifiers: *Grit, *Sewage screenings, *Chicago, Sanitary district, Waste heat recovery, Material handling, Wastewater treatment and plant design.

Detailed studies and a preliminary design of an incineration system for the disposal of grit, screenings, and scum from all of the wastewater treatment plants of the Metropolitan Sanitary District of Greater Chicago are reported by a firm of consulting engineers. The study included: (1) determination of quantities and characteristics of the waste materials; (2) material handling problems; (3) incineration processes; and (4) design, layout, and cost estimates of the proposed system. The report proposes the construction of an incinerator at the District's Southwest Treatment Works capable of handling 250 tons (wet) daily. Containerized truck hauling of grit, screenings, and scum from outlying District treatment plants to the Southwest plant is recommended, based upon cost comparisons with other methods. An incinerator proposed is a 7-hearth furnace designed to meet anticipated air pollution regulations and estimated load requirements in the year 1985. A waste-heat recovery system is considered feasible and is recommended (optional) for space heating, material thawing, and for use in the plant's power house. Construction costs (1970) are estimated at $2,631,000, and annual operating and maintenance costs, $138,600. (Poertner-Chicago)
W70-02029

OIL WASTE DISPOSAL FACILITY STUDY, SEATTLE AREA,
Cornell, Howland, Hayes and Merryfield, Seattle, Wash.
For primary bibliographic entry see Field 05D.
W70-02030

DISPOSAL OF DIGESTED SLUDGE TO PUGET SOUND--THE ENGINEERING AND WATER QUALITY ASPECTS/July, 1965.
Municipality of Metropolitan Seattle, Wash.

Municipality of Metropolitan Seattle, King County, Washington, July 1965. 75 p, 9 photos, 36 fig, 21 tab, 177 ref, 6 append.

Descriptors: *Sewage sludge disposal, *Sludge disposal, *Sewage disposal, *Oceanography, Sludge treatment, Water quality control, Anaerobic digestion, Monitoring, Costs, Beds under water, Sludge worms, Waste disposal, Chlorination, Hydarulic conduits, Hydraulic design.
Identifiers: *Puget Sound, *Seattle, Municipality of Metropolitan Seattle, Dilution of sludge, Submarine sludge outfall sewer, Ocean disposal of sewage sludge, Outfall diffuser.

The disposal of digested sludge from the West Point and Renton wastewater treatment plants serving Metropolitan Seattle by dilution in the waters of Puget Sound is recommended. The Municipality's staff and consultants agree that the quality of the receiving water can be suitably maintained for other beneficial uses and that the public health and welfare will be protected. A comprehensive water quality monitoring program is being established. The digested sludge would be screened to remove objectionable floatable materials, mixed with effluent from the primary treatment plant, and chlorinated prior to disposal into the Sound through a 96 inch diameter submerged outfall sewer. Jet mixing with sea water by a diffuser in the sewer will produce a dilution of more than 10,000 to one upon discharge. Ultimate disappearance of the sludge will result from combined effects of further volatization, hydrodynamic dispersion, sedimentation and flushing to the ocean. Little buildup of digested sludge solids on the bottom of the Sound is predicted. The sludge disposal method proposed is believed to be the most practical and economical of various alternatives considered. Similar sludge disposal methods are practiced successfully at Los Angeles. (Poertner-Chicago)
W70-02031

5F. Water Treatment and Quality Alteration

PESTICIDES IN DRINKING WATER: WATERS FROM THE MISSISSIPPI AND MISSOURI RIVERS,
Consumer Protection and Environmental Health Service, Cincinnati, Ohio.
M. L. Schafer, J. T. Peeler, W. S. Gardner, and J. E. Campbell.
Environ Sci and Technol, Vol 3, No 12, p 1261-1269, Dec 1969. 9 p, 1 fig, 8 tab, 6 ref.

Descriptors: *Pesticide residues, *Potable water, *Mississippi River, *Missouri River, DDT, Dieldrin, Endrin, Aldrin, Heptachlor, Water pollution sources, Sampling, Municipal water, Water supply, Water analysis.
Identifiers: Drinking water, DDE, HCE.

Over 500 grab samples of finished drinking water and related raw water were assayed for 10 organochlorine pesticides, their metabolites, and related compounds. The samples were collected between March 1964 and June 1967 from 10 selected municipal finished water supplies whose source was either the Mississippi or the Missouri River. Both 100-ml and 1-gallon sample sizes were assayed. Included is a statistical evaluation of the one-step extraction method using 1-gallon samples to which known amounts of the 14 compounds were added to levels ranging from 0.06 to 5.0 ppb. Over 40% of the finished water samples contained detectable dieldrin and more than 30% contained detectable endrin, DDT, and DDE. Twenty per cent of the 63 samples assayed for chlordan contained detectable concentrations; five of these were in excess of 0.25 ppb. Aldrin, HCE, and heptachlor were found only occasionally. No toxaphene nor methoxychlor was detected. (Knapp-USGS)
W70-01643

PERFORMANCE OF POROUS CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF HARD AND WASTE WATERS,
Ottawa Pollution Control Center (Ontario); and National Research Council of Canada, Ottawa (Ontario). Div. of Applied Chemistry.
For primary bibliographic entry see Field 05D.
W70-01644

SURVIVAL OF ADULT DREISSENA IN COPPER SULFATE SOLUTIONS OF DIFFERENT CONCENTRATION AND TEMPERATURE,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
V. S. Lukanin.
Translated from Trudy Instituta Biologii Vnutrennikh Vod, No 7 (10), 1964. Biology and Control of Dreissena, Jerusalem, Israel Program for Scientific Translations, 1968, p 69-70.

Descriptors: *Copper sulfate, *Molluscasides, Mollusks, Water supply.
Identifiers: *Dreissena.

Lethal doses of copper sulfate for adult Dreissena with 5 hours exposure were experimentally determined at 11 concentrations ranging from 0.0 mg/l to 24,300 mg/l and at 5 temperatures ranging from 12.5 deg C to 32.5 deg C. At temperatures below 22.5 deg C the lethal doses of copper sulfate are unpractically high. Exposure to 32.5 deg C for 5 hours in pure water resulted in 100% mortality. (Tyner-Washington)
W70-01791

THE EFFECT OF CERTAIN METAL IONS ON DREISSENA,
Akademiya Nauk SSSR, Moscow. Institut Biologii Vnutrennykh Vod.
V. F. Dudnikov, and V. P. Mikheev.
Translated from Trudy Instituta Biologii Vnutrennikh Vod, No 7 (10), 1964. Biology and Control of Dreissena, Jerusalem, Israel Program for Scientific Translations, 1968, p 60-64.

Descriptors: *Electrolysis, *Molluscasides, Ions, Mollusks, Pesticides, Pipelines.
Identifiers: *Dreissena, *Copper ions, *Silver ions, Lead ions, Mercury ions, Zinc ions.

One method for the elimination of Dreissena overgrowth in pipelines is the use of electrolytically dissolved metal ions. Silver, copper, mercury, zinc and lead were tested for their molluscasidal effect. Copper is the most effective (100% mortality in 24 hours at 4 mg/l). Larger mollusks die sooner than small ones. Dreissena perish sooner at water temperature optimal for their development. (Tyner-Washington)
W70-01792

FLOW THROUGH POROUS MEDIA: A STATISTICAL APPROACH,
Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
For primary bibliographic entry see Field 03A.
W70-01886

AERATION OF WAHNBACH RESERVOIR WITHOUT CHANGING THE TEMPERATURE PROFILE,
Wahnbachtalsperenverband, Siegburg (West Germany).
Heinz Bernhardt.
J Amer Water Works Ass, 5918, p 943-64, 1967.

Descriptors: *Temperature, *Thermal stratification, *Aeration, Manganese, Reservoirs, Impoundments, Stability, Hypolimnion, Fish, Plankton, Oxygenation, Economic efficiency, Phosphorus.
Identifiers: Artificial aeration.

Aeration and mixing of a 33,740 acre impoundment was found to be technically and economically feasible either by destratification by using the diffused air bubble method or by aeration of the hypolimnion only. Cold water for drinking was preserved by hypolimnion aeration inasmuch as destratification did not occur. O2 was maintained>0 in the hypolimnion and Mn++ concentrations were near 0. Mixing reduced the population of the algae Oscillatoria rubescens. The influence of destratification on the movement of phosphorus to the surface of the reservoir could not be determined, but eutrophic processes were not increased as no additional plankton occurred in the reservoir after mixing. The oxygen transfer, oxygenation capacity, and destratification efficiency of the devices described in this paper compare favorably with other aeration devices reported in the literature. (Novotny-Vanderbilt)
W70-01929

5G. Water Quality Control

SYSTEMS ANALYSIS FOR OPTIMAL WATER QUALITY MANAGEMENT,
Federal Water Pollution Control Administration, Edison, N.J.
For primary bibliographic entry see Field 05B.
W70-01766

COMBINED UNDERFLOW-STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA.
Department of Public Works, Chicago, Ill. Bureau of Engineering.

City of Chicago Dep Public Works, Bur Eng Rep, Sept 1969. 43 p, 13 exhibit, 6 tab.

Descriptors: *Storm runoff, *Waste water treatment, *Water pollution control, *Tunnels, *Illinois, Urbanization, Sewers, Sewage treatment, Drainage systems, Storm drains.
Identifiers: Combined sewer systems, Chicago Underflow-Storage Plan.

The basic concept of the Chicago Underflow-Storage Plan for Pollution and Flood Control is the use of a pattern of underground tunnels, sized so as to provide a rational and economical fusion and linear distribution of storage volume and conveyance capacity in a single pattern of cleansable tunnels, without the necessity for supplemental storage in caverns or quarries, without power development. All water remaining in the underground tunnels after each storm period will be pumped directly to the existing treatment works. The underflow-conveyance capacity takes advantage of the lowered water levels to be established in the Illinois Waterway at Lockport for flood control and improved navigation. The basic features of the Underflow-Storage Plan include: (1) 18,000 acre-feet of underground storage; (2) A combined outflow capacity by underflow and overflow of about 43,000 cfs; (3) Sufficient underground storage for any storm having a frequency of recurrence up to 100 years. The total capital cost of the proposed Combined Underflow-Storage Plan is estimated to be $650,000,000. (Knapp-USGS)
W70-01869

HOW TO BEAT THE HEAT IN COOLING WATER,
Sargent and Lundy, Chicago, Ill.
T. D. Kolflat.
Electrical World, Vol 170, No 16, p 31-33, Oct 14, 1968. 6 fig.

Descriptors: *Temperature, *Cooling towers, Cost comparisons, Reservoirs, Thermal pollution, Water cooling.
Identifiers: Spray-header cooling.

One method proposed for holding down the heating effect is to dissipate it to a greater volume of water. For example the heat discharged from a 1000 Mw plant will add 30F to a 1000 cfs flow, 3F to 10,000 cfs flow and 0.3F to 100,000 cfs. Another approach is to select the optimum condenser rise independent of dilution considerations and dilute the water after it leaves the condenser. In many areas the natural rolling topography lends itself to building reservoirs for cooling water which can provide recreational benefits also. A cooling tower attempts to accelerate the natural cooling process. Cooling-tower performance is a function of range and approach. In general, the mechanical-draft wet-type tower will have an optimum range of 21F and an approach of 18F, the natural-draft wet-type a range of 26F and an approach of 18F, the mechanical dry-type a range of 12F and an approach of 33F and natural-draft dry-type a range of 17F and an approach of 38F. (Upadhyaya-Vanderbilt)
W70-01915

SECONDARY EFFLUENT DEOXYGENATION AT DIFFERENT TEMPERATURES,
Marquette Univ., Milwaukee, Wis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-01921

COOLING-WATER DEBATE NEEDS CLARIFICATION,
Sargent and Lundy, Chicago, Ill.
T. D. Kolflat.
Electrical World, Vol 170, No 8, p 25-27, Aug 19, 1968. 6 fig.

Descriptors: *Temperature, *Thermal pollution, Fish, Thermal power.

The quantity of heat added to the cooling tower is essentially equal to that exhausted from the turbine. This exhaust heat can be reduced by modifying the basic thermal cycle. Each 100-psi increase in pressure of steam entering the turbine will decrease waste heat 0.4%. If the steam generated in the boiler is passed through a superheater the heat rejection will be reduced by about 1.4% for each 50F added. Another method of reducing heat from the turbine exhaust is to extract a portion of the steam from various points in the turbine and use it to heat water entering the boiler. This can reduce heat rejection up to 37%. There seems to be sufficient evidence to seriously question 93F as a water limit. Many plants have discharged water to rivers at 105F in summer with no adverse effect on aquatic life; fish have been caught alive in 105F water. Fish acclimatize to higher temperatures and migrate to and from areas not to their liking. Tolerance levels vary with different species and dissolved oxygen is above the minimum for fish at temperatures as high as 105 deg F. (Upadhyaya-Vanderbilt)
W70-01924

DIFFUSER DESIGN FOR DISCHARGE TO A STRATIFIED WATER,
Danish Isotope Center, Copenhagen.
P. Harremoes.
Water Research, Vol 2, p 737-752, Nov 1968. 12 fig, 20 ref.

Descriptors: *Stratified flow, *Sewage disposal, *Jets, Density stratification, Tracers, Design criteria.
Identifiers: *Stratified dispersion, Bacterial decay.

Results from several tracer experiments with submerged sewage fields in long-shore currents having pronounced stratification are used as a basis for the economical optimization of a discharge of domestic sewage through a diffuser. Existing theories on jet diffusion have been modified to fit the observed conditions, which have almost arbitrarily varying density distributions. A first approximation to dispersion in stratified flow is applied with data derived from tracer experiments. Bacterial decay is disregarded due to the very slow decay rates previously observed in The Sound, which is the strait between Denmark and Sweden. The computation of jet diffusion and stratified dispersion is computerized to meet the demand for a statistical prediction of pollution and for selecting the most economical design among the infinite number of possible outfall designs. Density effects on the sewage field are suggested to be of significance to design criteria for diffusers. (Rietveld-Vanderbilt)
W70-01928

AERATION OF WAHNBACH RESERVOIR WITHOUT CHANGING THE TEMPERATURE PROFILE,
Wahnbachtalsperenverband, Siegburg (West Germany).
For primary bibliographic entry see Field 05F.
W70-01929

AQUATIC WEED CONTROL WITH SODIUM ARSENITE,
Wisconsin State Board of Health, Madison. Committee on Water Pollution.
Kenneth M. Mackenthun.
Sewage and Industrial Wastes, Vol 22, No 8, p 1062-1067, Aug 1950. 20 ref.

Descriptors: *Aquatic weed control, *Sodium arsenite, Fish, Wisconsin, Lakes, Shores, Pondweeds, Chara, Copper sulfate, Bass, Eutrophication, Water pollution effects, Water pollution control, Water quality control, Herbicides.
Identifiers: Arrowhead, Water plantain, Bladderwort, Coontail, Waterweed, Wild cherry, Water crowfoot, Water milfoil, Bluegills, Crappies, Common pondweed, Bushy pondweed, Chemical weed control, Wisconsin Committee on Water Pollution, Horned pondweed.

Commercial sodium arsenite has been effectively used in the destruction of certain species of aquatic vegetation and the eradication of localized nuisances without harm to fish life. In Wisconsin its use has been authorized and supervised by an interdepartmental state committee for the past 10 years. Dosages up to 10 parts per million are recommended, depending on the physical character of the area to be treated. The time necessary for weed destruction after application of the chemical is usually about seven days. Treatment should be initiated when weeds are young and growing vigorously, so that a maximum amount of chemical will be absorbed by plant cells. Following destruction, weeds sink to the bottom and remain in place in the bottom muds. This procedure reduces the possibility of oxygen depletion caused by the decomposition of large masses of plant tissue. Decomposition rates are usually so slow that the oxygen balance is not greatly distorted. A history of the development of the program in Wisconsin is given in detail, as well as the method of application and the effect of such application on aquatic vegetation and aquatic organisms. (Jones-Wisconsin)
W70-01939

WATER POLLUTION CONTROL.

R I Gen Laws Ann secs 46-12-2, 46-12-3 (Supp 1968).

Descriptors: *Rhode Island, *Water pollution control, *Public health, *Pollution abatement, Abatement, Water pollution effects, Disposal, Environmental engineering, Legislation, Legal aspects, Wastes, Pollutants, Water polution sources, Water pollution treatment, Project planning, Planning, Surveys, Investigations, Administrative agencies, Federal government, Water quality, Supervisory control (Power).

The Director of the Department of Health is responsible for carrying out the state's water pollution control legislation. He may consult the Advisory Board of Water Pollution regarding policies and plans for control and abatement of pollution. The Department of Health is designated as the state's water pollution control agency for purposes of obtaining federal assistance under the federal Water Pollution Control Act. In addition to exercising general supervisions of the administration of the pollution law, the Director shall: (1) develop programs for prevention and abatement of new and existing pollution; (2) cooperated with federal and state agencies in planning or securing financial assistance; (3) conduct investigations and disseminate information concerning water pollution and its control and prevention; (4) modify or adopt standards of water quality; (5) administer state grants to political subdivisions for construction of sewer treatment works; (6) supervise construction of disposal systems; and (7) issue reasonable rules and regulations for the prevention, control, and abatement of pollution and enforcement of orders thereunder. (Kelly-Florida)
W70-02002

WATER QUALITY MANAGEMENT BY REGIONAL AUTHORITIES IN THE RUHR AREA,
Resources for the Future, Inc., Washington, D C.
Allen V. Kneese.
Controlling Pollution, Englewood Cliffs, N J, Prentice Hall, p 109-129, 1967. 21 p.

Descriptors: *Water quality management, *Water pollution, Economics, Regional analysis, Municipal wastes, Industrial wastes, Government, Watersheds, Rivers, Planning, Costs, Waste treatment, Taxes, Welfare economics, Effluents, Marginal costs, Prices, Flood control, Water supply, Water resources.
Identifiers: *Ruhr River, Social costs.

In this article the author describes how pollution has been successfully checked by a method which combines regional cooperation and management with a system of economic charges to polluters. A review of the background and concepts underlying water quality management in the United States is provided with the conclusion that achieving clean streams will involve public investment far higher than in any other field of resources development or conservation. This provides the framework for discussion of the German experience. The cost assessment procedures and effluent charges are outlined. Generally, it is found that economic incentives have been used successfully to control the pollution of manufactures and municipalities. The article concludes, however, with a discussion of some of the difficulties and deficiencies in this method of pollution control. (Murphy-Rutgers)
W70-02004

EFFLUENTS AND AFFLUENCE,
Federal Reserve Bank of Boston, Mass.
Jared E. Hazelton.
New England Business Review, p 2-9, June 1965. 8 p.

Descriptors: *Regional analysis, *Water pollution, Rivers, Streams, Costs, Benefits, Waste disposal, Water resources development, Municipal wastes, Industrial wastes, Recreation, State government, Federal government, Flood control, Planning.
Identifiers: *Zoning, *Classification of rivers, Scenic value.

This article describes the zoning approach used by the New England Interstate Water Pollution Control Compact. This regional authority classifies sections of rivers and streams according to a scale of potential water uses, balancing the costs of treatment and dumping restrictions against the benefits that various kinds of water use bring to the community. An attempt is made to estimate the progress in water pollution control through the increased number of treatment plants constructed. The role of the federal and state governments is reviewed. The article concludes with some recommendations for necessary changes in the area. (Murphy-Rutgers)
W70-02012

OIL DISPERSING CHEMICALS, A STUDY OF THE COMPOSITION, PROPERTIES AND USE OF CHEMICALS FOR DISPERSING OIL SPILLS,
Federal Water Pollution Control Administration, Edison, N.J. Water Quality Lab.
Melvin Z. Poliakoff.
Available from Clearinghouse as PB-188 207 $3.00 in paper copy, 0.65 in microfiche. FWPCA Water Pollution Control Research Series, ORD-3, May 1969. 27 p, 23 ref. FWPCA Program Number 15080FHS 05/69.

Descriptors: *Dispersion, *Emulsifiers, *Water pollution control, *Reviews, Chemical analysis, Chemicals, Detergents, Oil, Surfactants, Testing, Emulsions.
Identifiers: *Oil spillage.

A 'state-of-the-art' review is provided for chemicals which are used for dispersing spilled oil. Among the topics discussed are: the history of the development of oil spill dispersants; basic emulsion chemistry, including the nature and properties of surface active agents; chemical composition of oil spill dispersants, including a description of generic chemical types; production of dispersants, properties of dispersants; chemical analysis of oil spill dispersants; and the measurement of oil spill dispersing power.
W70-02037

A MODEL FOR QUANTIFYING FLOW AUGMENTATION BENEFITS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
E. E. Pyatt, J. P. Heaney, G. R. Grantham, and B. J. Carter.
Available from the Clearinghouse as PB-188 208 $3.00 in paper copy, 0.65 in microfiche. Final Report to Federal Water Pollution Control Administration, USDI, Southeast Region, Atlanta, Ga, Sep 1969. 630 p, 52 tab, 58 fig, 184 ref, 5 append. FWPCA Grant No 16090 DRM.

Descriptors: *Systems analysis, *Benefit - cost analysis, *Flow augmentation, Water quality control, River basins, Reservoirs and impoundments.

With increasing quantitative and qualitative demands being placed upon national water resources, improved management practices are vitally needed. In principle, one powerful management tool is systems analysis, wherein mathematical optimizing techniques are employed to effect rational tradeoffs between competing demands for water use, but this tool, in turn, rests upon the availability of methodologies for quantifying the benefits (economic value) of each water-use category. That is, systems analysis, before it can be employed comprehensively, demands a knowledge of the functional value of irrigation, flood control, municipal water supply, etc. Little is known of the economic implications of low flow augmentation, one of the important water-use categories. Beginning with the premise that the value of low flow augmentation is measured by sewage treatment costs avoided, a hydrologic flow simulator and a water quality linear programming model were interfaced to develop a procedure for determining 'willingness to pay' for augmentation. This generalized approach can be applied by others to their specific water pollution control situations.
W70-02039

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

CRITICAL PATH METHOD OF WORK SCHEDULING,
Department of Water and Power, Los Angeles, Calif.
Robert U. Olson.
J Amer Water Works Ass, Vol 61, No. 9, p 447-454, September 1969. 8 p, 12 fig, 2 ref.

Descriptors: *Critical path method, *Scheduling, *Resource allocation, *Network design, *Simulation, Computers, Project allocation, Control systems construction costs, Construction materials.
Identifiers: Early start time, Late start time.

The step-by-step procedure for the development of a critical path method (CPM) was given. The objective of the study was to demonstrate by a construction project example the step-by-step organization and use of the critical path method of scheduling. Thirteen steps were outlined. The steps ranged from the listing of all activities that were required to be performed for the completion of the project to maintaining project control by instituting a regular reporting system. The early start time (EST) and the late start time (LST) were calculated and a critical path determined. The critical path was the longest time path through the network, and was indicative of the time it would take to complete the job. The critical path had two main characteristics, (a) it passed through all events were EST and LST were the same, (b) it was continuous from the start of the project to the end. The use of a computer to simulate CPM network diagrams was recommended. It was concluded that CPM would indicate the most practical way accelerate completion of the project, and in the scheduling of material delivery, provide information on the effects of changes and allow for a more effective utilization of resources. (Thiuri-Cornell)
W70-01765

PAPER (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY) (IN FRENCH),
Antoni Arkuszewski, and Todeusz Wierzbicki.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sect 1, Subj 4, p 117-127, 1969. 11 p, 2 tab.

Descriptors: *Navigable rivers, Concrete-lined canals, Optimum development plans, *Inland waterways.
Identifiers: *Traffic capacity, Canalized rivers.

Particular sectors of waterways in Poland have various gauges, which influence the traffic capacity. The free-flowing rivers have large traffic capacities. The capacity of locks are not as great and depends on the speed of opening and closing, and of filling and emptying of locks. Also, the speed of ships coming in and going out of the locks is an important factor. For each waterway the optimum size of ships which allow for the maximum capacity of the waterway may be determined. An example of the optimization of traffic capacity of the Odra is included. In order to increase the traffic capacity of waterways the following conclusions are suggested: unify the gauges of channels and its conditions of navigation; unify the size of ships, as far as possible; the locks should be equipped with protective installations, the locks should be well lighted for day and night use; the capacity of ports should be greater than the capacity of waterways. The article is written in French and includes an English summary. (Grossman-Rutgers)

W70-01843

REGIONAL ECONOMICS,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 06B.
W70-02018

FORECASTING WITH ECONOMETRIC MODELS: AN EVALUATION,
State Univ. of New York, Stony Brook.
For primary bibliographic entry see Field 06B.
W70-02024

A MODEL FOR QUANTIFYING FLOW AUGMENTATION BENEFITS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 05G.
W70-02039

6B. Evaluation Process

WATER AND LAND RESOURCES OF ARKANSAS,
Arkansas Soil and Water Conservation Commission, Little Rock.
For primary bibliographic entry see Field 10.
W70-01701

DEVELOPMENT PROBLEMS IN ARID ZONES,
Raymond Furon.
IN The Problem of Water: A World Study, New York American Elsevier, p 135-162, 1967.

Descriptors: *Arid lands, *Land reclamation, *Arable land, *Climatology, *Semiarid climates, Irrigable land, Dendrochronology, Human resources, Land resources, Water resources, Economics, Deserts, Population, Permafrost.
Identifiers: *Israel, *Greece, *Algeria, *Sahara, Egypt, Nile River, Fossil water.

Arid lands of the world might be brought under cultivation to meet the need for food by an expanding world population. Large uncultivated areas of the world are listed. Much of these regions is unsuitable mountain country, frozen waste or true desert without accessible water. Many semiarid lands have once been cultivated and might be again if economically sound means were devised to deliver irrigation water. Over the long run reclamation plans should consider dependability of water supply in view of long term weather cycles. The author identifies 'false deserts' as areas with a dependable source of water which have become unproductive through neglect or misuse and resulting erosion. Greece and Israel are examples that are being reclaimed through careful planning and management. The author emphasizes and gives examples of the need for careful planning, thorough physical and human resource surveys and sound management in successful arid land reclamation. (Crouse-Arizona)
W70-01805

COST-BENEFIT ANALYSIS OF PASTURE IMPROVEMENT IN THE ARID REGION OF RAJASTHAN,
Agro-Economic Research Centre, Vallabh Vidyanagar (India).
For primary bibliographic entry see Field 03F.
W70-01809

PROJECTIONS OF NET INCOME AND WATER USE IN PINAL COUNTY, ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04B.
W70-01812

THE GEOGRAPHICAL BACKGROUND OF THE JORDAN WATER DISPUTE,
Moshe Brawer.
In: C A Fisher, ed, Essays in Political Geography, 1968, London, Methuen, p 225-242. 2 maps, 10 ref.

Descriptors: *Arid lands, *Irrigation programs, *Pumping, *Water resources development, *Political aspects, Water quality, Chlorine, Costs, Rivers, Water shortage, Institutional constraints, Foreign countries.
Identifiers: *Israel, *Jordan River, *Jordan, Sea of Galilee, Syria, Political Geography.

The author reviews the geographical and historical background of the Jordan water dispute. Well over half of Israel has an average rainfall of less than 8 inches. Israel has already developed virtually all of the fresh water resources under its control. If further agricultural and economic growth is to proceed, Israel must draw on large quantities of Jordan River water. Such development is disputed by the Kingdom of Jordan and by Syria, through which the head waters of the Jordan run. Syria has successfully blocked the originally planned diversion project for Jacob's Daughter's Bridge, from which water would have flowed by gravity to the western deserts of Israel. Instead, water is lifted by costly pumping from the Sea of Galilee, which is within Israel's geographic boundaries. Substantial savings in evaporative losses are realized, however. Far more efficient use of the Jordan's waters could be affected by cooperative development by all the nations concerned rather than by individual national development schemes. (Crouse-Arizona)
W70-01833

REGIONAL CONSIDERATION OF FLOOD PLAIN PLANNING,
Bi-State Metropolitan Planning Commission for Scott County, Iowa and Rock Island County, Ill.
William S. Luhman.
In: Flood Plain Management, Iowa's Experience, Iowa State University Press, Ames, Iowa, p 93-102, 1969. 1 fig, 10 ref.

Descriptors: *Planning, *Coordination, *Regions, Flood plains, Regional analysis, Local governments, Management, Iowa, Land use.
Identifiers: Scott County, Iowa, Bi-State Metropolitan Planning Commission.

This article focuses on the development of effective regional planning programs which relate to flood plain management. The existing pluralistic local government system cannot deal effectively with regional problems. Therefore, there is a need for some sort of regional cooperative planning for the continued growth and development of these urban regions. The Federal government has recognized this problem and several acts have been passed requiring regional coordination in application for grants. Local elected officials are also giving recognition to the necessity of individual local governments joining together in solving their related and frequently interdependent urban problems. Identification of goals and objectives, the need for cooperative regional planning, the preparation of a regional land-use plan and problems of effectuating a regional plan are discussed. A specific example of the Bi-State Metropolitan Planning Area in Scott County, Iowa and Rock Island, Illinois, is used to illustrate problems of coordination in regional planning. The conclusion reached is that it is futile to attempt regional planning without similar programs in operation along the length of the river, based upon a total river basin program. The real contribution the regional approach makes is to begin coordinating the many local jurisdictions within each of the respective regions along the river. (Marriott-Chicago)
W70-01837

TECHNIQUES FOR DEVELOPING A COMPREHENSIVE PROGRAM FOR FLOOD PLAIN MANAGEMENT,
Iowa State Univ., Ames.
Merwin D. Dougal.
In: Flood Plain Management: Iowa's Experience (Iowa State University Press, Ames, Iowa 1969), p 53-75. 7 fig, 32 ref.

Descriptors: *Flood control, *Water management (Applied), Flood forecasting, Flood damage, Flood protection, Water control, Iowa.
Identifiers: *Flood plain management.

The steps required to implement an action program for a flood plain management program are outlined. An action program provides for recognition of the flood hazard, flood forecasting, flood fighting emergency measures, short-range plans for alleviating flood damages, and long-range plans to accomplish the wise use of flood plain areas. The indirect and direct methods of reducing flood damages through control of floodwaters are reviewed in some detail. Flood forecasting and warning systems can be implemented swiftly at little cost to the community. Flood fighting and emergency protection measures can assist in reducing flood losses. Engineering works for flood control provide additional measures for direct and effective control of flood water and permit substantial reductions of flood losses where they are economically feasible. In conclusion, the author states that although the implications for funding, organization, and personnel appear great if all these endeavors are to be accomplished in a modicum of time, existing agencies can be used at the federal level and in most states. A reorientation or strengthening of activities is a major requirement at several levels of government, but mainly at the state and local levels. Each of these measures should be considered a part of the total flood plain management program for a river basin or for acceptance by a state government. (Marriott-Chicago)
W70-01838

MAN SHOULD MANAGE THE FLOOD PLAINS,
James E. Goddard.
In: Flood Plain Management: Iowa's Experience, ed by Merwin D Dougal (Iowa State University Press, 1969), p 11-21. 7 ref.

Descriptors: *Flood plains, *Management, Political aspects, Adoption of practices, Flood control, Flood plain zoning, Multiple-purpose projects.
Identifiers: *Flood plain management.

The article includes basic discussion of the meaning of flood plain management, a review of the historic role of flood plain utilization and attendant flood damages, and enlarges upon the need for comprehensive and broad approaches to management. Broader programs now being developed are discussed and it is pointed out that success in flood plain management depends upon cooperation between all agencies and levels of government. Recommendations for more effective action given in some detail are briefly: (1) Improve public relation and programs for informing the public so there will be necessary support for action programs; (2) arrange state conferences directed toward developing better understanding of the respective federal, state, and local roles and of their relationship in flood plain management; (3) accelerate the effort of the federal government; (4) enlarge the roles of the states and encourage term to accept greater responsibility in programs to assist their citizens; and (5) increase the role of local governments (city, county, and regional) and their acceptance of greater responsibility. (Marriott-Chicago)
W70-01839

METROPOLITAN WATER RESOURCE MANAGEMENT AS AN EMERGING SPECIALIZED TECHNICAL AREA: A STATE-OF-THE-ART AND LITERATURE REVIEW,
Chicago Univ., Ill. Center for Urban Studies.
John R. Sheaffer, Shirley A. Starr, George Davis, and Alan Richmond.
Available from the Center for Urban Studies, University of Chicago, for $3.00 per copy. Center for Urban Studies, University of Chicago, 1969. OWRR Project W-107. 124 p, 4 fig, 7 tab, 5 append, 1 plate.

Descriptors: *Water resources development, *Project planning, Research and development, Regional analysis, Decision making, Federal project policy.
Identifiers: *Metropolitan water resource management, *Regional integration.

The primary objective of this study is to increase understanding of the present status of the rapidly evolving and potentially beneficial metropolitan water resource management strategy. Through a selective literature search and analysis of materials being produced on metropolitan water resource management, and through a systematic analysis and comparison of theoretical statements and statements made by urban water managers, an interest area has been delineated. The results of this study identify the progress that has been made and the agreement which has been reached. Identified also are the critical research needs and the deficiencies which exist in present metropolitan water resource management efforts.
W70-01840

PAPER: (NAVIGABLE WATERWAYS BANK PROTECTION) (in French),
Behorde fuer Wirtschaft und Verkehr, Hamburg (West Germany).
Kurt Feuerhake, Rudolf Hintze, Werner Hoffmann, Heinrich Meyer, and Hand Theodor Schroder.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr Paper, Sect 1, Sub. 6, Inland Navigation, p 5-36, Paris, 1969. 29 fig.

Descriptors: *Retaining walls, *Canal design, Navigable waters, Transportation, *Inland waterways.
Identifiers: *Main-Danube canal, *North Sea-Baltic Sea canal.

The importance of stresses due to traffic on the behavior of bank revetments is stressed. It is necessary to ascertain the forces to which these structures are submitted through full-scale and laboratory tests. The Main-Danube canal in the Bamberg reach was selected for testing inland navigation. For the testing of ocean navigation the North Sea-Baltic Sea Canal was chosen. The bank revetment must be designed to safely absorb the energy developed furing the passage of vessels. The design and the choice of the revetment also depends on materials available and their cost, on conditions of construction on estimated duration of the revetment, and on maintenance costs. The paper is written in French and contains a summary written in English. (Grossman-Rutgers).
W70-01841

PAPER: (NAVIGABLE WATERWAY BANK PROTECTION) (IN FRENCH),
Ghent Rijksuniversiteit (Belgium).
Marcel Van Cauwenberge, and Paul Lagrou.
IN: perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sect 1, Subj 6, p 37-48, Paris, 1969. 7 p, 4 fig.

Descriptors: *Retaining walls, *Canal design, Erosion control, Plastics, *Inland waterways.
Identifiers: Ghent-Burges Canal.

Two examples of slope consolidation are presented: (1) Bank consolidation by means of rubble-filled gabions and (2) Temporary bank consolidation along the Ghent-Burges Canal consisting of a double row of polyethylene perforated plates. These plates must resist air, acid, base, salt and frost effects. The use of polyethylene sheets was the most economical alternative available. The article is written in French and contains an English summary. (Grossman-Rutgers)
W70-01842

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Buenos Aires Univ. (Argentina).
R. A. Frederico Prestein.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sect 1, Subj 4, p 21-34, 1969. 14 p, 5 maps.

Descriptors: *Navigable rivers, *River systems, Mississippi River, Maintenance costs, Investment, *Inland waterways.

The problems of developing and operating waterways in a country which is itself undergoing development, are set out. A general account of the economy of waterway transport is made. The navigable waterways of Argentina are the Plata, Parana, Paraguay and Uruguay. The size of the river fleet is examined. Navigation conditions on the Parana are compared with those on the Mississippi. The numerous river ports should be either abandoned where there is little traffic or should be industrially developed. The author distinguishes between the infrastructure of the waterway itself (channels, navigable passes, signalling) and stationary installations connected with the waterway (river ports, shore terminals, handling and storage equipment); ships and boats using the waterway in question, a difference being made between ocean-going ships and river boats. Increasing the natural depth of rivers means not only investments but also increased maintenance costs. However, increased tonnage may reduce freight charges. The article is written in English and contains a resume written in French. (Grossman-Rutgers)
W70-01844

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY) (IN FRENCH),
Bundesverkehrsministerium, Bonn (West Germany).
Dr. Gerhard Wiedemann, Burkart Rumelin, Emil Renner, Werner Behle, and Joachim Michael.
In: Perma Int Asso of Navigation Congr XXIInd Int Navigation Congr, Paper Sect 1, Subj 4, Paris, p 5-20, 1969. 16 p, 2 tab, 1 fig, 5 ref.

Descriptors: *Inland waterways, Psychological aspects.
Identifiers: *Transport capacity, *Traffic density.

Influencing factors and a technique for determining the transport capacity of a waterway section without locks are discussed. The traffic flow of a waterway is affected by the human factor, the actions of ship navigators, as well as the dimensions of the ships and the waterway. This human influence can be quantified by distinguishing various categories in the traffic flow which depend on the traffic density. Determination is possible for typical cases of movement, which govern the categories. Relative traffic densities are established for the main movement cases, for a standard ship and a two-lane canal. These densities are used to determine the admissable traffic density for a section and a selected traffic sequence. The equation traffic quantity equals traffic density times speed, gives us the technical operating capacity as a boundary value for the traffic quantity. The traffic capacity can be derived from this equation. The article is written in French and includes a summary written in English. (Grossman-Rutgers)
W70-01845

GENERAL REPORT: (METHODS FOR ASSESSING THE TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Ingenieur General dea Ponts et Chaussees.
Ph. Deymie.
In: Perma-Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sect 1, Subj 4, p 1-26, 1969. 26 p.

Descriptors: Navigable waters, *Economics, *Inland waterways.
Identifiers: Transportation capacity.

The General Report presents summaries of the reports on inland navigation by the following countries: Germany, Argentina, France, Italy, Japan, The Netherlands, Poland, and the United States of America. The purposes of these reports are to select parameters and determine methods for assessing transport capacity of navigable waterways, taking into account the composition of the river fleet and economic factors abstracts of these reports are forwarded with their particular publications. Two copies of the general report are included: One report is written in English and one in French. (Grossman-Rutgers)
W70-01846

PAPER: (TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY),
Netherlands Rijkswaterstaat, The Hague.
H. A. Ferguson, H. Engel, and S. I. E. Blok.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sec 1, Subj 4, p 97-115, 1969. 18 p, 6 fig.

Descriptors: *Navigable rivers, *Channels, Inland waterways.
Identifiers: *Traffic capacity, Volkerak locks, The Hague.

The navigable waterways in the Netherlands must be able to take the ever-increasing amount of traffic and meet the increase in sea port activities. The capacity of a navigable waterway depends on a large number of parameters. Some of these, such as the principle characteristics of the waterway, its cross-section of discharge, its lay-out and its dominant currents, are easy to determine. Other parameters are difficult to evaluate: the reciprocal action of the waterway on the boats and vice versa, and the action of the boats on one another. Three methods of traffic analysis are distinguished: calculation, study on models, and in site observations. The capacity of a waterway and degree of traffic fluidity are defined and examined. The Volkerak locks are described as to traffic capacity. The article is written in English with the summary and conclusions written in French. (Grossman-Rutgers)
W70-01848

PAPER: (TRANSPORT CAPACITY OF AN ARTIFICIAL WATERWAY) (IN FRENCH),
Navigazione Interna e Trasporti Internazionali, Milan (Italy).
Dr. Ing. Mario Tanci.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper, Sect 1, Subj 4, p 53-76, 1969. 24 p, 3 tab.

Descriptors: *Artificial water courses, Economic impact, *Channels, Inland waterways.
Identifiers: *Transport capacity.

The transport capacity of an artificial waterway depends upon its characteristics ans specifically on: the number of locks, their distribution along the waterway and their output; and the river fleet and its degree of heterogeneity which influences the possibility of regulating the traffic which, in its turn, is in relation with social and economic condition of adjacent regions, and in relation with influential areas and competitive conditions with other means of transportation. The deductive method is used in assessing the transport capacity of an artificial waterway in Italy. An economic prospect of the proposed artificial waterway is that industrial factories can be set up near to distribution and consumer centers. Surveys are made to determine the zones of influence of each river port and to define the consequent industrial localities. The article is written in Italian and contains an English summary. (Grossman-Rutgers)
W70-01849

PAPER: (EVALUATION OF THE TRANSPORT CAPACITY OF A NAVIGABLE WATERWAY) (IN FRENCH),
Michel Rousselin.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper, Sect 1, Subj 4, p 35-52, 1969. 18 p, 1 tab, 1 fig.

Descriptors: *Simulation analysis, *Locks, Canals, Mathematical studies.
Identifiers: *Optimum economic capacity.

This paper is largely concerned with the notion of capacity of a lock or group of locks of a canal or canalized river. Two methods are explained for determining this capacity. The first method, called the classic method, consists of calculating, for a lock, the optimum economic capacity, from the theoretical maximum annual capacity, by applying a number of reduction factors. The second, called the simulation method, determines the optimum economic capacity by utilizing the results of simulation on computers using programs established on the basis of a mathematical model. With this method the laws of arrival of boats and their dimensions, as well as traffic fluctuations, are taken into account less empirically than the classic method. Both methods are discussed thoroughly. The article is written in French and contains an English summary. (Grossman-Rutgers)
W70-01850

ANALYSIS OF SHIPPING TRAFFIC CAPACITY OF NARROW WATERWAYS - ON THE URAGA CHANNEL,
Ministry of Transport (Japan).
Shunsaku Nishida, Nobuo Watanabe, and Hajime Eguchi.
Perma Int Asso of Navigation Congr XXIInd Int Navigation Congr, Paper, Sect 1, Subj 4, p 77-96, 1969. 20 p, 8 fig, 6 tab.

Descriptors: *Systems analysis, *Channels, Open channel flow.

Utilizing traffic forecasts for the bay ports, and assuming the relationship between that traffic and the traffic passing through the channel to be constant, it is possible to ascertain the latter for the forthcoming years. Furthermore, assuming the distribution of traffic between the various categories of ships to be invariable, it is possible to estimate future traffic for each of these categories. A simulation model is used to determine future traffic. Two types of data are used: those relative to the shape, length, width, and navigation rules of the fairway; and those relative to the speed and safety perimeter of ships. Traffic is calculated on a basis of maximum ship density at the peak hour. The simulation model furnishes the admissible volume of traffic. Plans for the development of the channel are examined. The article is written in English and contains a summary written in French. (Grossman-Rutgers)
W70-01851

USES OF SMALL URBAN RIVER VALLEYS,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
Ira L. Whitman.
Corps of Engineers, Baltimore District, P O Box 1715, Baltimore, Md 21203, Apr 1968. 310 p, 26 tab, 24 fig, 16 photo, 128 ref, 2 append.

Descriptors: *Land use, City planning, Recreation, Parks, Environmental effects, Value.
Identifiers: *Urban river valleys, Land-value enhancement.

Small river valleys and their land uses were studies in Baltimore, Bridgeport, Fort Wayne, Milwaukee, San Antonio and Washington. Valley park areas are considered in relation to valley properties, and the recreation uses best suited to those properties are determined. A method is developed for rating quality of natural environment in urban valleys. A dependency of urban valley environment upon land use was established. Recreation is closely related to physical conditions and properties. Many recreation activities are enhanced by a high degree of natural environment in urban valleys. Valley planning should begin with measures to preserve and maintain existing qualities. Valley development should be judged on its effect upon existing valley environment. Environmental analyses must accompany valley planning. (Grossman-Rutgers)
W70-01852

URBAN REDEVELOPMENT IN INDIANAPOLIS: A BENEFIT-COST ANALYSIS,
Connecticut Univ., Storrs.
Stephen D. Messner.
Journal of Regional Science, Vol 8, No 2, p 149-158, Winter 1968. 10 p, 12 ref.

Descriptors: *Economic impact, *Investment, *Cost-benefit analysis, *Urban renewal, *Government, Resource allocation, Federal government, Costs, Project planning, Financing, Benefits, Value, Programs.
Identifiers: *Slums, Spillover, Social costs, Social benefits, Land value, Redistribution effects, *Redevelopment.

This study considers the validity and effectiveness of benefit-cost analysis, with particular application to selected redevelopment projects in Indianapolis, Indiana. The form of the analysis first developed by Jerome Rothenberg is used to study the benefits of slum clearance in the area. There were three possible benefits studied: (1) internalizing externalities affecting land use; (2) the spillover effects on other properties; and (3) the reduction of certain slum-associated external social costs. The author finds that the application of benefit-cost analysis to urban redevelopment is clearly not yet at the point where projects and alternatives may be ranked with the technical precision found in the area of water resource development. Although not concerned specifically with water resources, this article provides valuable insights into the application of benefit-cost analysis to public investments which should prove useful to the water researcher. (Murphy-Rutgers)
W70-02006

CRITERIA FOR EVALUATING REGIONAL DEVELOPMENT PROGRAMS,
Tennessee Valley Authority, Knoxville.
John V. Krutilla.
American Economic Review, Vol XLV, No 2, p 120-132, May 1955. 13 p.

Descriptors: *Regional analysis, *Investment, Economics, Cost-benefit analysis, Income, Financing, Agriculture, Natural resources, Capital, Demand, Water resource development, Reservoirs, Costs, Supply, Statistics, Benefits.
Identifiers: *Regional development, *TVA, MPC, Regional multiplier.

This paper discusses the nature of the problem of regional development. The author claims that an approach which attempts to evaluate each program activity individually (for its impact on the sector of the economy toward which it is directed) is superior to regional comparisons of relative change in economic indicators. This is due to errors in the latter method as well as the national orientation of many programs. Benefit-cost analysis is found to be useful as an investment criterion rather than an evaluation criteria in the region of the development program. The most fruitful approach is an analysis of the process of development and how regional development programs may influence that process. Both because of its numerous references to the TVA and the significance of regional development programs in the water resources area, this article has relevance to water program evaluation methods. (Murphy-Rutgers)
W70-02009

URBAN AREA WATER CONSUMPTION: ANALYSIS AND PROJECTIONS,
West Virginia Univ., Morgantown.
For primary bibliographic entry see Field 06D.
W70-02010

THE BURDEN OF THE DEBT AND FUTURE GENERATIONS IN LOCAL FINANCE,
Miami Univ., Oxford, Ohio.
For primary bibliographic entry see Field 06C.
W70-02011

EXTERNALITIES, WELFARE, AND THE THEORY OF GAMES,
Carnegie Inst. of Tech., Pittsburgh, Pa.; and Yale Univ., New Haven, Conn.
Otto A. Davis, and Andrew Whinston.
The Journal of Political Economy, Vol LXX, No 3, p 241-262, June 1962. 22 p.

Descriptors: *Welfare economics, *Government, Taxes, Optimization, Government supports, Industrial production, Benefits, Costs, Equilibrium, Mathematical studies, Prices, Marginal cost, Economics, Pricing, Profit.
Identifiers: *Externalities, *Welfare maximization, *Separability.

It is usually said that if firms create external economies and diseconomies, the proper role of a welfare-maximizing government is to constrain the behavior of firms by arranging rates of taxes and subsidies in order to equate private with social benefits. The authors establish the conditions under which this policy will work and of those under which it won't. They argue that firms act to eliminate externalities through mergers, that technological externalities can be divided into separable and non-separable and that the classical scheme will work only in the separable cases. If the externality is non-separable, the classical prescription cannot work even at the conceptual level. The authors attempt to circumvent the problems presented by this to policy makers by several alternative policy approaches. Due to the externalities often found in wate resource projects, this article should prove applicable in understanding the theoretical implications of externalities in the water resource area. (Murphy-Rutgers)
W70-02013

ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR,
Bowdoin Coll., Brunswick, Maine.
For primary bibliographic entry see Field 06C.
W70-02014

PLANNING 1968.
American Society of Planning Officials, Chicago, Ill.

Selected Papers from the ASPO National Planning Conference, San Francisco, May 4-9, 1968. 322 p.

Descriptors: *Planning, *Conservation, Resources, Government, Economics, City planning, Social change, Political aspects, Statistics, Transportation, Education, Regional analysis, State government, Long-term planning, Area redevelopment.
Identifiers: *Economic development, Physical planning standards, Urban design.

This is a collection of papers presented at the American Society of Planning Officials (ASPO) annual conference. The bulk of the papers are concerned with the various aspects of city planning. Sections are devoted to such subtopics of this area as city rioting, city government, sociological factors, education, and state influences. There is a large section, however, on the influence of economics and economic development on the conservation area. Papers are presented on alternative uses of the natural environment, conservation and exploitation as well as the influence of the economist on the 'new' conservation. Although concerned with the larger area of conservation in general, the principles developed and suggestions made should prove directly applicable to the area of water resource planning. The proceedings conclude with papers comparing the results of planning in Alaska, Hawaii and Puerto Rico. (Murphy-Rutgers)
W70-02015

A NOTE ON THE MEASUREMENT OF THE BENEFITS FROM PUBLIC INVESTMENT IN NAVIGATION PROJECTS,
Chicago Univ., Ill.
Edward F. Renshaw.

American Economic Review, Vol XLVII, No 5, p 652-662, Sept 1957. 11 p, 1 fig, 1 tab.

Descriptors: *Investment, *Benefits, *Costs, Navigation, Government supports, Multipurpose projects, Interest rate, Discount rate, Economics, Cost-benefit analysis, Demand, Water conveyance, Harbors, Rivers.
Identifiers: *Corps of Engineers, Discounting, Social costs, Incremental costs, Opportunity costs.

In this paper an attempt is made to apply elements of economic theory to the established procedure used by the Corps of Engineers to estimate navigation benefits from federal navigation improvement projects. The author wishes to see whether or not contemporary public investment in navigation projects can be reasonably justified on the basis that expected benefits will exceed costs. Thus, the theory underlying benefit estimation is outlined and the Corp's benefit estimation procedures judged by these standards. The measurement and discounting of navigation costs is discussed and an argument is made for a more realistic analysis. The author's main conclusion is that navigation costs ought to be reimbursed by the direct beneficiaries rather than by public subsidy. (Murphy-Rutgers)
W70-02016

SECONDARY BENEFITS, EXTERNAL ECONOMIES AND THE JUSTIFICATION OF PUBLIC INVESTMENT,
California Univ., Berkeley.
Julius Margolis.
Review of Economics and Statistics, Vol XXXIX, No 3, p 284-291, Aug 1957. 8 p.

Descriptors: *Indirect benefits, *Irrigation, Capital, Costs, Labor, Government, Cost-benefit analysis, Transportation, Income, Water resources, Project planning, Prices, Equilibrium, Marketing profits, Dams, Planning.
Identifiers: *External economies, *Bureau of Reclamation, Social costs.

One argument often used to justify public services is that the benefits of the activity cannot be limited to the direct recipients of the services. These benefits, which accrue to a large sector of the nation, are indirect benefits. This paper focuses on the use of the concept and its measurement by the Bureau of Reclamation. The types of public investments studied are dams and distribution systems for irrigation projects. The concept and measurement of secondary benefits is discussed. A large section is devoted to attacking the claim that secondary benefits develop because of expansion in complementary industries. The author feels that the procedures followed by the governmental agencies are confusing and incorrect but that secondary benefits can be significant. The author states that the Bureau should compare the economic growth of Western areas with irrigation against those Eastern areas with soil-treatment programs. (Murphy-Rutgers)
W70-02017

REGIONAL ECONOMICS,
Illinois Univ., Urbana.
Hugh O. Nourse.
New York, McGraw-Hill Inc, 1968. 240 p.

Descriptors: *Regional analysis, *Mathematical models, Labor, Resources, Demand, Transportation, Federal government, Average cost, Cost, Income, Input-output analysis, Government planning.
Identifiers: *Income distribution, Capital supply, Trade, Markets, Central places.

This book was meant to serve as an introduction to location theory and regional economic development. Since it studies the geographic allocation of scarce resources the water resource planner is consequently a vital participant in this field. The book constructs economic models of the spatial pattern of economic activity which fit into the traditional models of the economy. Of interest to the water researcher are the sections on industrial location patterns dealing with geographic dispersion of manufacturing and variations in input prices. The measurement of regional economic activity and the interregional theory of income and trade are discussed. The chapters on regional economic growth and the impact of growth on regional structure contain much of the theory necessary for successful water development. The final chapter is on the role of government in solving some of these problems. (Murphy-Rutgers)
W70-02018

THE USES AND ABUSES OF ECONOMICS,
Hull Univ. (England).
Eric Roll.
Oxford Economic Papers, Vol 20, No 3, p 289-302, Nov 1968. 14 p.

Descriptors: *Resource allocation, *Growth rates, Government, Economics, Management, Investment, Income, Stabilization, Demand, Political aspects, Economic evaluation.
Identifiers: *Economic policy, Monetary policy, Fiscal policy, Macro-economics, Balance of payments.

The author takes, as his main theme, the application of the understanding which economic analysis can provide towards the better ordering of human affairs. With the increased use of economics in the water resource area, an understanding of its limitations and possibilities is essential to the water resource planner. The author points out the faults he finds with the main tools of economic management and monetary and fiscal policy. The author regards with suspicion the speed with which new economic tools have been adopted. The necessity for vigilence in regard to the relation between state and private interests is mentioned. The author also feels there is excessive confidence in the efficacy of economics when faced with wider issues of the world of politics. (Murphy-Rutgers)
W70-02019

A SOCIAL ACCOUNTING SYSTEM FOR REGIONAL DEVELOPMENT PLANNING,
Iowa Univ., Iowa City.
Jerald R. Barnard.
Journal of Regional Science, Vol 9, No 1, p 109-116, Apr 1969. 7 p, 2 tab, 11 ref.

Descriptors: *Planning, *Income, *Regional analysis, Input-output analysis, Capital, Government, Budgeting, Economic analysis, Statistics, Investment.
Identifiers: *Accounting system, *Flow-of-funds accounts, *Social accounting system, Development planning, Structural adjustment, Depreciation.

This paper considers the types of information that would be useful in a system of social accounts for analyzing economic change with reference to regional development planning. It presents an overview of a system of accounts in the form of social accounting matrix that was developed for generating information about state economic structures. The social accounting matrix provides an accounts system that is descriptive of the various transactors of a state economy and indicates the interrelationships among sectors. It is a seventy-sector matrix that incorporates the concepts underlying input-output tables and income and product accounts. The system uses a set of multiple classifications which prove to be interesting because they provide a means of more accurately depicting the functional relationships among the sectors. Since regional development planning is an integral part of water resource planning, this article should be informative to the water researcher. (Murphy-Rutgers)
W70-02020

SHIFT AND SHARE PROJECTIONS OF REGIONAL ECONOMIC GRWOTH: AN EMPIRICAL TEST,
Indiana Univ., Bloomington. Inst. for Applied Urban Economics.
H. James Brown.
Journal of Regional Science, Vol 9, No 1, p 1-17, Apr 1969. 17 p, 7 tab, 15 ref.

Descriptors: *Regional analysis, *Planning, Economic analysis, Competition, Employment, Marketing, Labor supply, Population.
Identifiers: *Shift and share projections, *Economic growth, Variation, Covariation, Industry growth rates.

This paper reports on an empirical test of a shift and share projection model and an analysis of the competitive component over time. The author develops the projection model and compares its projections with those of two simple alternative models. The results show that shift and share projections are less precise than either of the alternatives. The author also examines the critical competitive component in the hope of discovering why the model projects poorly and how well the competitive component reflects the economic forces that have been ascribed to it. The analysis casts coubts on the ability of the technique to predict and even to describe regional economic growth. Due to the important role of water development in regional planning, this article should prove of interest to water resource planners. (Murphy-Rutgers)
W70-02021

PROPOSED PRACTICES FOR ECONOMIC ANALYSIS OF RIVER BASIN PROJECTS.
Inter-Agency Committee on Water Resources, Washington, D.C.

Report to the Inter-Agency Committee on Water Resources, Subcommittee on Evaluation Standards, May 1958. 56 p.

Descriptors: *Cost-benefit analysis, *River basin development, *Cost allocation, *Irrigation, *Flood control, *Multiple-purpose projects, Planning, Prices, Interest rate, Cost, Sharing, Direct benefits, Indirect benefits, Income, Economic analysis, Economic justification, Discount rate, Project life, Taxes, Labor, Drainage, Navigation, Risks, Amortization.
Identifiers: *Tangible benefits, *Intangible benefits, Land acquisition, Cost measurement, Risk allowances.

The first chapter of this paper serves to acquaint the reader with previous studies of benefit-cost ciriteria. The basic principles and concepts involved in benefit-cost analysis are discussed in Chapter II. Attention is focused on effects attributable to water projects, the nature of benefits, and the effects of alternative opportunities on evaluation and project formulation. Chapter III covers general principles and procedures for project and program formulation. The standards, problems and procedures involved in the measurement of benefits and costs are the subject of Chapter IV. There include among others, price levels, interest rates, risk allowances, tangible and intangible benefits, treatment of costs of effected public facilities and treatment of taxes. Chapter V is concerned with the applications of principles and procedures for analysis of various project purposes. The application of data on benefits and costs in allocation of costs among project purposes is discussed in the last chapter. (Murphy-Rutgers)
W70-02022

WATER RESOURCE INVESTMENT AND THE PUBLIC INTEREST,
Grinnel Coll., Iowa.
Robert H. Haveman.
Nashville, Tennessee, Vanderbilt University Press, 1965. 199 p.

Descriptors: *Regional analysis, *Water resource development, Cost allocation, Benefits, Economic analysis, Political aspects, Income analysis, Risks, Economic efficiency, Capital, Cost-benefit analysis, Interest rate, Investment, Flood control, Project life, National income, Welfare economics, Political aspects, Government.
Identifiers: *Income distribution, *Depressed areas, *Regional development, *Congress, *Corps of Engineers.

This book is a regional study dealing with appropriations to the Corps of Engineers projects in ten southern states since World War II. It assumes that the Federal endeavor must have as its goal the maximization of social welfare depending on the size and distribution of national income. Thus, the two forces of economic efficiency and income distribution are analyzed as determinants of water resource appropriations. The formal process of project evaluation is described, the importance of the two concepts as Congressional criteria discussed and an analysis is made of the income distribution effects of projects in ten southern states. Postwar projects are evaluated according to their economic efficiency and the effect of this criteria on regional income distribution is discussed. In the final section an attempt is made to combine both of these primary determinants of changes in economic welfare into a single multidimensional approach. (Murphy-Rutgers)
W70-02023

FORECASTING WITH ECONOMETRIC MODELS: AN EVALUATION,
State Univ. of New York, Stony Brook.
H. O. Stekler.
Econometrica, Vol 36, No 3-4, p 437-463, July-Oct 1968. 27 p.

Descriptors: *Model studies, *Forecasting, *Mathematical studies, Economic justification, Economic analysis, Gross National Product, Income, Economics, Taxes, Government, Investment, Cycles.
Identifiers: *Econometrics, *Ex post, *Ex ante, Coefficients, Disposable income, Inventory, Housing.

The paper attempts to determine the ability of existing econometric models to generate quantitative forecasts of aggregate economic activity. The models evaluated are the Klein Quarterly Model, the OBE Model, the Fromm Model, the Lice Model, the Friend and Jones Models, and the Friend and Taubman Model. The main characteristics of each model are reviewed and the variety of methods that may be utilized to evaluate these models are discussed. The combination of all the results suggests that econometric models have not been entirely successful in forecasting economic activity. The results could be more meaningful if all the models had been tested on data for the same period or if those predictions had been compared with projections which had been generated by other techniques. The growing role of econometric models in water resource planning makes this article relevant to the water area. (Murphy-Rutgers)
W70-02024

CRITERIA FOR UNDERTAKING WATER-RESOURCE DEVELOPMENTS,
California Univ., Berkeley.
Joe S. Bain.
American Economic Review, Vol L, No 2, p 310-320, May 1960. 11 p.

Descriptors: *Project planning, *Water resource development, Social aspects, Investment, Budgeting, Irrigation, Prices, Water rates, Optimization, Benefits, Economics, Costs, Intangible benefits, Demand, Income, Interest rate, Capital, Operating costs, Capital costs, Discount rate.
Identifiers: *Social welfare, *Investment criterion.

The article evaluates the criteria for undertaking water-resource development projects in view of the social priorities which alternative criteria may express or implement. The author treats: (1) the general investment criterion, as defined in terms of the relation of benefits to costs and as made specific for assumed constraints on the investing agency's budget; (2) THE INTEREST RATE TO BE USED IN DISCOUNTING FUTURE EVENTS AND COSTS; (3) the timing of investment and the avoidance of premature investment; and (4) the influence of procedures in benefit calculation on the design of projects, with attention given to the role of intangible benefits. The author feels that increased attention is needed to the choice of theory in light of information on actual institutional constraints, to the promulgation of constraint systems, and to detailing the manner in which the procedures for applying theoretical investment criteria may alter the content of the criteria as applied. (Murphy-Rutgers)
W70-02025

THE PROCESS OF MAKING GOOD DECISIONS ABOUT THE USE OF THE ENVIRONMENT OF MAN,
Calgary Univ. (Alberta).
Louis Hamill.
Natural Resources Journal, Vol 8, No 2, p 279-301, Apr 1968. 1 tab, 21 ref.

Descriptors: *Decision making, *Operations research, *Methodology, Economics, Planning, Forecasting, Education.
Identifiers: Process orientation, Alternative actions, Decision-making criteria.

After summarizing objections to economic theory as a basis for making decisions on resource use, the article presents an alternative procedure derived from operations research and management science. Section I described a simplified decision model, based on five premises: (1) decision is required only when there are alternative actions, only one of which may be taken; (2) each alternative will have different consequences; (3) efficient decision making requires consideration of all possible alternatives; (4) decision makers must have a set of criteria to evaluate all combinations of alternatives; and (5) action will be taken immediately on the preferred alternative. Section II considers procedures that make the decision model operational, including: (1) initiation of the process; (2) identification of alternative actions; (3) how to forecast consequences of action; (4) stating objectives; (5) ranking combinations of actions and consequences in terms of objectives; and (6) stating instructions for action. The decision process should be continuous because external conditions, available techniques or objectives may change. Use of the operational procedure for decision making will have important implications for the education of resource analysts. This approach will reduce the amount of education required for competent analysts by reducing present reliance on theoretical subjects. (Gossen-Chicago)
W70-02026

PRESERVATION VALUES IN RIVER BASIN PLANNING,
Izaak Walton League of America.
Roger Tippy.
Natural Resources Journal, Vol 8, No 2, p 259-278, Apr 1968. 56 ref.

Descriptors: *Preservation, *Water resources development, Legislation.
Identifiers: *Comprehensive planning, *Consideration of alternatives, *Democratic decision making, Congressional powers, Corps of Engineers, Federal Power Commission, Department of the Interior, Upper Missouri River basin.

Section I delineates preservation values from development values. Federal policy on comprehensive planning, as expressed in Senate Document 97, holds that planners should present decision makers a choice of alternatives. Experience reveals that planners compromise the several values to present a single answer. Section II illustrates this point by examining development decisions of the Corps of Engineers, the Federal Power Commission and the Department of the Interior. Section III analyzes past preservation decisions and present legislative proposals. It is recommended that a Scenic Rivers Act be passed to create a format for making affirmative preservation decisions about a river's use, and to require that development recommendations explicitly consider preservation alternatives and vice versa. Section IV gives an example of such comprehensive planning. Representing conflicting interests in the Upper Missouri River, the Department of the Interior and the Corps of Engineers jointly produced a booklet illustrating the possibilities of full development, full preservation and various compromises. Resultant debates delayed decision making, but allowed decision makers and private citizens to express their preferences. The article recommends that Congressional Committees on Natural Resources be established with the power to select among all alternative uses. (Gossen-Chicago)
W70-02027

WATERFRONT PLANNING - COMPREHENSIVE PLANNING OF LAKE MICHIGAN SHORELAND,
Chicago Univ., Ill. Dept. of Geography.
Peter T. Haverkampf.
Lake Michigan Region Planning Council, Project 65-1, 1967. 110 p, 5 maps, 86 ref.

Descriptors: *Lake Michigan, Submerged Lands Act, Wisconsin, Indiana, Illinois, Michigan, Federal jurisdiction, State jurisdiction, Riparian rights, Shore protection, Recreation demand, Industrial water, Land use, Landfills, Inter-agency cooperation, Long-term planning.
Identifiers: *Regional planning, *Comprehensive planning, *Conflicting uses, *Waterfront development.

Lake Michigan shoreline lands provide two general categories of uses for two general purposes: personal well-being and economic well-being; these two categories are often not compatible. The author contends that generally it is better to plan for the separation of the two categories of use. Pressures on the resource are increasing--it is easier to increase steel plant production by filling new land than by clearing urban areas. It is easier to state highway planners to put a road on newly made land than to condemn a right-of-way in a heavily populated area, and it is easier to put a water filtration plant or sewage treatment facility on the lake than to run underground pipes and clear areas for inland location. These uses have been proliferating on the shoreline, with the resulting increased pressure for lakefront land. Amelioration of these pressures is made difficult by the fragmented jurisdiction of control over submerged lands and from the various statutes which the four states bordering on Lake Michigan have. The author sees the necessity of an interstate planning authority having the kinds of planning powers that the Tennessee Valley Authority possesses. (Starr-Chicago)
W70-02032

INTRODUCTION TO THE SUBMERGED AND SHORE LAND PROBLEM,
Chicago Univ., Ill. Dept. of Geography.
Peter T. Haverkampf.
In: Waterfront Planning - Comprehensive Planning of Lake Michigan Shoreland, Lake Michigan Regional Planning Council, 1-8, 1967. 5 maps, 86 ref.

Descriptors: *Shore protection, *Lake Michigan, Recreation demand, Industrial water, Land use.
Identifiers: *Conflicting uses, *Comprehensive planning, *Waterfront development, Non-conforming use, National use.

The attributes of the Lake Michigan shoreland are given, and the necessity of planning for the use of this resource is stressed. The importance of providing 'vista' within an urban context is the outstand-

ing attribute of a resource such as Lake Michigan. Closely related to the 'vista' is the unique water-land relationship. Passive and active pleasures which are provided by such a resource, are oftentimes denied because access to lakefronts are traditionally used for water transportation and commercial development in urban areas. Since certain recreation and industrial uses demand riparian rights, criteria should be established to reconcile conflicting demands. Author distinguished between natural or unconforming uses. If a shoreline, as a limited resource is fully utilized, the use is natural; if full advantage of the location is not utilized, due to the nature of the use, the use is unconforming. The example of the Indiana Dunes area is cited as an example of unresolved conflicts between industry and recreation groups, with the result that the limited resource, Lake Michigan is under-utilized. The author suggests resolution of this problem by enforcing strictly the idea of natural uses of the shoreland. Existence of a deep water port for heavy industry would be permissible; however, the industry itself should extend landward rom the port, rather than along the shore. Similarly, recreation uses that are not dependent upon the shoreline should also be placed away from the shore so as to allow more room for natural uses. (Starr-Chicago)
W70-02033

FEDERAL, STATE, AND LOCAL CONTROLS OVER SUBMERGED AND SHORE LAND,
Chicago Univ., Ill. Dept. of Geography.
Peter T. Haverkampf.
In: Waterfront Planning - Comprehensive Planning of Lake Michigan Shoreland, Lake Michigan Regional Planning Council, Project 65-1, p 8-22, 1967. 5 maps, 86 ref.

Descriptors: *Lake Michigan, Submerged Lands Act, Wisconsin, Indiana, Michigan, Illinois, Riparian rights, Federal jurisdiction, State jurisdiction.
Identifiers: *Public Law 31.

The difficulty in making comprehensive plans for the Lake Michigan shoreline, lies in the fact that there is no central authority. Four state governments (Michigan, Illinois, Wisconsin and Indiana) have the power to regulate these lands. Further complicating the jurisdictional problem is the fact that these state governments have delegated to other governing bodies control over the submerged lands. Legislation such as the 'Submerged Lands Act' of 1953 and Public Law 31 give federal sanction to the states for control over submerged lands. Variations in the state laws of the four states surrounding Lake Michigan cause widely divergent patterns of industry, public and private development. The state laws are summarized and discussed. The author suggests that the development of riparian law in the respective states is an important reason for these divergent patterns. (Starr-Chicago)
W70-02034

FOUR CASE STUDIES: THE PRESENT POSITION OF LANDFILL PLANNING PROBLEMS,
Chicago Univ., Ill. Dept. of Geography.
Peter T. Haverkampf.
In: Waterfront Planning - Comprehensive Planning of Lake Michigan Shoreland, Lake Michigan Regional Planning Council, Project 65-1, p 22-72, 1967. 5 maps, 86 ref.

Descriptors: *Lake Michigan, *Recreation demand, *Industrial water, Landfills, Land use.
Identifiers: *Comprehensive planning, *Conflicting uses, *Waterfront development.

As a result of the fragmented jurisdiction over submerged and shoreland land use of Lake Michigan, the shoreline must be viewed as a scarce resource. The situation in Chicago, where recreational uses have almost complete control over the city's Lake Michigan shoreline is little better than the situation in Gary, Indiana, where the highest bidder controls almost all the shore. Present legal structure is analyzed in order to understand problems and possibilities for shoreline land use. Land use on the Milwaukee lakefront is cited as exhibiting a balance of uses that comes close to an optimal utilization of the lakeshore and submerged land resource. A review of the Illinois Central Railroad and Lake Michigan Landfill in Chicago is made. Supreme Court rulings which returned all riparian rights to the city and chastised the State of Illinois for giving away control of submerged lands ultimately ended the Illinois Central's control of land. The United States Steel submerged lands controversy is seen as emerging because of lack of mutual planning and cooperation between industry and conservationists. Because of its location on the Illinois-Indiana boundary, multi-state planning is needed to provide for both recreational and industrial uses. The Indiana Dunes conflict is given as a prime example of conflicting demands upon a limited resource. The compromise which was eventually reached was one-sided. The need for some planning authority to reconcile the intense competition between the steel companies and the conservationists is emphasized. (Starr-Chicago)
W70-02035

EXISTING GOVERNMENTAL AIDS TO COMPREHENSIVE LAKE MICHIGAN SHORELINE PLANNING,
Chicago Univ., Ill. Dept. of Geography.
Peter T. Haverkampf.
In: Waterfront Planning - Comprehensive Planning of Lake Michigan Shoreland, Lake Michigan Regional Planning Council, Project 65-1, p 72-100, 1967. 5 maps, 86 ref.

Descriptors: *Lake Michigan, *Submerged Lands Act, Federal project policy, *Inter-agency cooperation, Long-term planning.
Identifiers: *Regional planning, *Comprehensive planning, *Federal aid, Technical assistance.

The scope of a plan would utilize the shore to its optimal potential, and yet provide all necessary and natural shoreline uses, is outlined. The plan, at the minimum, should encompass regional planning, especially in terms of the four states surrounding the lake, but also in viewing the Lake Michigan basin as part of the Great Lakes region. Because of the concentration of people in two major urban centers, Chicago and Milwaukee, recreational and industrial needs must be met in a region which does not follow political or economic boundaries. Reviewed are the statutory devices, inter and intra-state regional planning groups, state authorities, local governmental powers and potential individual efforts available for providing such a regional plan. Federal aids to comprehensive Lake Michigan Shoreline Planning include: (1) financial and technical assistance in establishing the best land resource allocation on a local level; (2) financial help for land purchase; (3) support of local planning programs; and (4) federal participation in the land market, through purchase of land. The failure of comprehensive planning for the Lake Michigan shorelands is seen as the result of the fact that ultimate responsibility still rests at the local level. Even though local power is derived from the state, this condition has come about because of a lack of interest in planning at the state level. The author concludes that a 'foresighted and neutral authority' can control the resource for the best long term development. (Starr-Chicago)
W70-02036

A MODEL FOR QUANTIFYING FLOW AUGMENTATION BENEFITS,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 05G.
W70-02039

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ALTERNATIVE FEDERAL POLICIES FOR STIMULATING STATE AND LOCAL EXPENDITURES: A COMPARISON OF THEIR EFFECTS,
Board of Governors of the Federal Reserve System, N.Y.
Edward M. Gramlich.
National Tax Journal, Vol XXI, No 2, p 119-129, June 1968. 11 p, 2 tab.

Descriptors: *Government, *Economics, Federal government, State government, Local government, Budgeting, Government supports, Taxes, Statistics, Interest rate, Model studies, Capital, Income analysis.
Identifiers: *Expenditures, *Grants-in-aid, *Bloc grants, Utility analysis, Fiscal policy, Monetary policy.

This paper compares the effects of several alternative Federal policies, either in existence or under discussion, which influence the budgets of states and localities. The policies include three kinds of grants: matching; grants-in-aid; unconditional bloc grants; and bloc grants conditioned with effort formulas; along with monetary policy; Federal personal tax reductions and income tax credit. The basis of the paper is a utility maximization analysis for state and local governments. The first section of the paper sets out the utility analysis and shows how alternative policies would enter into the second section uses statistical estimates of the relevant parameters to give quantitative measures of the state and local response to Federal policies. This article has relevant to the water resource area due to the increasing number of stimulative grants by the Federal government to states and localities in this field. (Murphy-Rutgers)
W70-02005

THE MAGNITUDE OF THE DISCOUNT RATE FOR GOVERNMENT PROJECTS,
Auburn Univ., Ala.
William C. Miller.
The Southern Economic Journal, Vol XXVIII, No 4, p 348-356, Apr 1962. 9 p.

Descriptors: *Discount rate, *Interest rate, *Government, Project planning, Benefits, Costs, Taxes, Capital, Inflation, Employment, Budgeting, Economic efficiency, Financing, Demand, Income, Population, Economic feasibility.
Identifiers: *Social costs, Economic evaluation.

Using the work of Otto Eckstein as a point-of-departure, the author investigates the proper size of the discount rate for government projects. He argues that an average of rates of interest and returns in the private sector sets too high a minimum. He believes that substantially the same discount rate appropriate for projects financed by taxation under circumstances of full employment should be used during mild inflation but not hyperinflation. He proves that substantially the same discount rate should be used regardless of the level of employment. In addition, until all alternatives have been investigated and found wanting, the discount rate should not be lowered to promote development of lagging regions. Due to the large amount of government investment in the water resource area and the important role of the discount rate in cost benefit analysis this article should be of value to the water resource planner. (Murphy-Rutgers)
W70-02007

THE PURE THEORY OF PUBLIC EXPENDITURE,
Massachusetts Inst. of Tech., Cambridge.
Paul A. Samuelson.
The Review of Economics and Statistics, Vol 36, No 4, p 387-389. Nov 1954. 3 p.

Descriptors: *Welfare economics, *Marginal utility, Economics, Mathematical studies, Government, Finance, Pricing, Taxes, Budgeting, Prices.
Identifiers: *Collective goods, *Private goods, Consumption, Utility curve, Production-possibility schedule, Marginal principle, Marginal rate of substitution, Voting.

The author assumes two categories of goods, private and collective consumption goods, with individuals having ordinal preferences and a convex and smooth production-possibility schedule relating totals of all outputs. Given the normal social welfare function the optimal state is defined by the marginal conditions stated by the author in the equations. However, there is no decentralized pricing system which can serve to determine, optimally, the levels of collective consumption. Various kinds of voting outlined by the author are shown to be inadequate. Due to the public good aspects of the water resource area the basis of public expenditures theory for public goods provided in this pioneering article should improve theoretical understanding of water problems. (Murphy-Rutgers)
W70-02008

THE BURDEN OF THE DEBT AND FUTURE GENERATIONS IN LOCAL FINANCE,
Miami Univ., Oxford, Ohio.
George C. Daly.
Southern Economic Journal, Vol XXXVI, No 1, p 44-51, July 1969. 8 p.

Descriptors: *Debt, *Financing, *Taxes, Costs, Economics, Local government, Income, Capital, Benefits, Value.
Identifiers: *Burden of debt, *Local debt, Tax shifting, Intergeneration incidence, Internal debt, External debt.

There is a large quantity of debt issued by municipalities, school districts, and states, which is held primarily by individuals who do not reside within the boundaries of the issuing entity. The author wishes to examine to what extent, if any, this type of government debt imposes a burden on the future. The author examines the recent literature and finds the traditional argument to be that because local borrowing is largely external, it can shift the cost of current projects to future generations. The burden under alternative financing schemes of debt financing and taxation is examined under two different sets of assumptions. The author finds the traditional arguments to be weak and finds that there exists no fundamental distinction between internal and external public debt with respect to the question of intergeneration incidence. Due to the importance of local debt financing in many water resource projects this article is relevant to the water area. (Murphy-Rutgers)
W70-02011

EXTERNALITIES, WELFARE, AND THE THEORY OF GAMES,
Carnegie Inst. of Tech., Pittsburgh, Pa.; and Yale Univ., New Haven, Conn.
For primary bibliographic entry see Field 06B.
W70-02013

ADVOCACY AND RESOURCE ALLOCATION DECISIONS IN THE PUBLIC SECTOR,
Bowdoin Coll., Brunswick, Maine.
A. M. Freeman.
Natural Resources Journal, Vol 9, No 2, p 166-175, Apr 1969. 10 p, 13 ref.

Descriptors: *Resource development, Taxes, Government supports, Benefits, Economic justification, Costs, Value, Model studies, Resource allocation.
Identifiers: *Information availability, Resource cost, Grand Canyon, Sierra Club.

The economists' discussion of resource allocation decisions in the public sector has concentrated on either developing rules for making optimizing decisions and analytical techniques to support these rules or the normative and positive analysis of the decision-making process. The author desires to explain the observed set of public decisions and to suggest ways of altering the framework within which the decisions are made so as to produce better decisions. Thus, a particular structure for making decisions in the public sector is considered and its implications for achieving an optimum resource allocation is discussed. Conclusions are reached on the role of available information and the side effects in decision-making as well as the role of organizations seeking to influence the process. Due to the large part played by the public sector in water resource development this article should prove useful. (Murphy-Rutgers)
W70-02014

SECONDARY BENEFITS, EXTERNAL ECONOMIES AND THE JUSTIFICATION OF PUBLIC INVESTMENT,
California Univ., Berkeley.
For primary bibliographic entry see Field 06B.
W70-02017

A SOCIAL ACCOUNTING SYSTEM FOR REGIONAL DEVELOPMENT PLANNING,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06B.
W70-02020

WATER RESOURCE INVESTMENT AND THE PUBLIC INTEREST,
Grinnel Coll., Iowa.
For primary bibliographic entry see Field 06B.
W70-02023

6D. Water Demand

WATER MANAGEMENT - A FASHIONABLE TOPIC,
Kline (Charles H.) and Co., Fairfield, N.J.
D. R. Dykes, T. S. Bry, and C. H. Kline.
Environ Sci Technol 1, p 780-84, 1967. 7 tab.
Identifiers: *Water costs estimate, *Water utilization, Agriculture, Ground water recharge, Industries, Product water treatment.

Some of the most important methods of water management are flood control, weather control, pollution control, reuse by recycling, renovation, desalination, and geographic location of the water user. The total estimated U.S. intake of water in 1965 was 356 billion GPD - already more than the available supply of 315 billion GPD. The intake of water in the U.S. will grow at nearly 2.4% a year. Industry has the highest growth rate at 2.8%, followed by steam electric utilities and public water at 2.7% a year each. Use for irrigation is only expected to grow at 1.8% a year. Ground water is the cheapest, ranging from no treatment cost to 20 cents/1000 gal. Surface water treatment costs run from 20 to 40 cents/1000 gal. Waste water can range from 20 to 65 cents/1000 gal. Desalination is still too expensive, $1.00/1000 gal, except in a few select locations. Estimated water renovation costs are listed for 15 different methods. These range from 15 cents/1000 gal for ground water spreading to 66 cents/1000 gal for wet oxidation. (In this table, distillation is listed at 62 cents and electrodialysis at 32 cents.)
W70-01746

WATER RESOURCES APPRAISAL OF THE WARM SPRINGS--LEMMON VALLEY AREA, WASHOE COUNTY, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
For primary bibliographic entry see Field 03B.
W70-01806

A BRIEF APPRAISAL OF THE WATER RESOURCES OF THE WALKER LAKE AREA, MINERAL, LYON, AND CHURCHILL COUNTIES, NEVADA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
For primary bibliographic entry see Field 03B.
W70-01807

PAPER: (DETERMINING THE CAPACITY OF THE ST. LAWRENCE SEAWAY),
St. Lawrence Seaway Development Corp.
Richard H. Miller, Brendon T. Jose, and Carl H. Gaum.
In: Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Paper Sect 1, Subj 4, p 129-150, 1969. 22 p, 5 charts, 1 map.

Descriptors: *Systems analysis, Costs, *Channels, *Inland waterways.
Identifiers: *St. Lawrence Seaway, *Traffic capacity, Economic optimum.

The technical characteristics of the Seaway, and its navigation period are presented. The technical capacity of a waterway in one navigation direction is defined as being the number of boats on the tonnage passing a certain point per unit of time. There are three types of navigation on a section of navigable waterway: free navigation, fully regulated navigation, and restricted navigation. A discussion of the parameters needed for simulation methods is included. The economic capacity of a navigable waterway is defined by an economic optimum corresponding to minimization of the sum of the following costs in relation to the kilometric-ton transported: annual amortization installments of infrastructure expenditure; annual cost of infrastructure operation and maintenance; annual cost of operating the fleet. In conclusion, it appears necessary to perfect accurate methods of determining the capacity of a navigable waterway and the corresponding costs. Also, an economic optimum should be sought, rather than a maximum capacity. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-01847

URBAN AREA WATER CONSUMPTION: ANALYSIS AND PROJECTIONS,
West Virginia Univ., Morgantown.
Robert J. Saunders.
Quarterly Review of Economics and Business, Vol 9, No 2, p 5-20, Summer 1969. 16 p, 4 tab.

Descriptors: *Economic forecasting, *Least squares method, *Regression analysis, Regional analysis, Conservation, Water utilization, Productivity, Water supply, Water policy, Temperature, Income, Elasticity of demand, Elasticity of supply, Prices, Costs.
Identifiers: *SMSA's, *Free good, *Priorities, Demographic factors, Principal component analysis, Vectors, Urban area size, Per capita water use.

This article deals with the recent increasing concern that water may become a relatively scarce resource in the foreseeable future due to current inefficiencies in water usage. One possible solution is a definite set of priorities for water usage, especially in urban areas where higher productivity uses abound. This article tries to identify factors which, on an aggregate basis, are closely associated with, or which determine, the level of water usage in urban areas and, on the basis of these factors, construct a forecast of water usage for a number of alternative urban areas in the U.S. in 1975. Variations in urban water usage, economic, demographic and water data form the basis for the identification of the various factors. This data was analyzed by principal component analysis and least-squares regression analysis. The factors arrived at related urban size with population and studied income variations, housing differences, and available plumbing, as well as rent and per capita production of water. City size was most important, followed by area income level and per capita water usage.

Using this information, water usage projections were made for 1975. (Murphy-Rutgers)
W70-02010

6E. Water Law and Institutions

CONSERVATION BONDS.

Pa Const Art 8 sec 16.

Descriptors: *Pennsylvania, *Government finance, *Land reclamation, *Water resources development, Resource development, Water resources, Conservation, Financing, Natural resources, Planning, Water conservation, Pollution abatement, Land resources, Drainage, Mine drainage, Water pollution, Sewage, Sewage treatment, Pollution, Water pollution control, Strip mines, Mine wastes, Recreation facilities, Recreation, Acid mine water.

The state may issue bonds for a Land and Water Conservation and Reclamation Fund to be used for the conservation and reclamation of land and water resources, including the elimination of acid mine drainage, sewage and other pollution from the state's streams. The provision of state financial assistance to political subdivisions and municipal authorities shall be for sewage treatment plants, restoration of abandoned strip-mined areas, fighting mine fires, alleviation and prevention of mining operations subsidence, and reclamation and development of park and recreational lands, subject to conditions and liabilities prescribed by the General Assembly. (Smith-Florida)
W70-01673

BULKHEAD LINE: THE LIFELINE OF OUR COASTS,

For primary bibliographic entry see Field 04A.
W70-01704

COUNTY PORT AUTHORITY.

Miss Code Ann secs 7605-01, 7605-06, 7605-09 (1956), as amended, (Supp 1968).

Descriptors: *Mississippi, *Port authorities, *Harbors, *Engineering structures, Legislation, Administrative agencies, Bodies of water, Channels, Navigable waters, Navigation, Ships, Transportation, Cities, Beds, Ownership of beds, Land reclamation, Eminent domain, High water mark, Banks, Lakes, Docks, Piers, Railroads.

A County Port Authority, or a Development Commission in larger counties, may be established upon a resolution by the county supervisors in any county bordering on the Mississippi Sound or the Gulf of Mexico in which a municipality has a harbor handling foreign exports or in which there is a harbor or channel over twenty feet in depth. The Authority has jurisdiction over ports, terminals, harbors, and channels as well as the vessels, wharves, common carriers and public utilities using the same within the county. County supervisors are authorized through the above bodies to improve and develop harbors, channels, and other navigation projects and to develop land for related industrial operations. Harbor facilities and equipment may be leased to private interests by the county following the procedures and limitations prescribed. The county may reclaim submerged lands and tidelands belonging to the state and may exercise the power of eminent domain over private lands. Any Authority has jurisdiction over lands below the mean high tide mark of any river, bay, or lake which are within or adjacent to any port or harbor, and they may be reclaimed for the development of the port. (Douberley-Florida)
W70-01762

COMMERCIAL FISHING DEVICES.

Ill Ann Stat ch 56, secs 192-224 (Smith-Hurd 1967), as amended, (Supp 1969).

Descriptors: *Illinois, *Commercial fishing, *Fishing gear, *Equipment, Legislation, Regulation, Fishing, Commercial shellfish, Electrical shocking gear, Trawling, Nets, Mussels, Permits, Sport-fishing, Sport fish, Lake fisheries.

The terms commercial fisherman and commercial fishing devices are defined. Traps, nets, or seines have restricted use relative to the size of the fish that may be taken. Seasons and size limits for mussels are regulated. Regulations for fish transported into the state and fish taken from waters wholly or in part within the state are provided. Commercial fishermen shall keep accurate records of their catch. Regulatory provisions pertaining to illegal fishing devices such as otter trawls, snares, spears, firearms, artificial lights, and drugs are included. Seining regulations are set forth as are refulations pertaining to lawful net types and sizes. Licensed commercial fishermen must maintain licenses in their possession for the equipment being used. It is unlawful to fish on private property without the consent of the land owner. (Moulder-Florida)
W70-01769

STATE PORTS AND HARBORS ACT.

Miss Code Ann sec 7564-04 (Supp 1968).

Descriptors: *Mississippi, *Harbors, *Piers, *Rivers, Legislation, Administrative agencies, Channels, Inland waterways, Docks, Ships, Boats, Beds, Ownership of beds, Lakes, Land reclamation, Dams, Dam construction, High water mark, Administration.

The Mississippi Agricultural and Industrial Board may acquire and operate ports, harbors, waterways, piers, elevators, loading and unloading facilities, vessels, terminals, and other facilities for the convenient use of commerce. The Board's powers include: (1) the deepening or enlarging of ports, harbors, and waterways; (2) the damming of waterways; (3) the development of industrial sites; and (4) the reclaiming of submerged lands. The Board is vested with jurisdiction and control of all lands below the mean high tide mark that are in or near any state-owned or operated ports, harbors, and waterbodies. (Douberley-Florida)
W70-01770

FISH AND FISHING GENERALLY: FOOD FISH.

Va Code Ann 28.1-47 thru 28.1-57 (1969).

Descriptors: *Virginia, *Shellfish, *Fish management, *Commercial fishing, Permits, Fish establishment, Reasonable use, Productivity, Regulation, Fish conservation, Fishing, Nets, Recreation, Fyke nets, State jurisdiction, Tidal waters, Legislation, Legal aspects, Taxes.

Residents of the state desiring to catch fish in the tidewaters under state jurisdiction, with any device other than a hand line, must be licensed. For the use of fixed fish taking devices, residents must procure a license in the district where the fixed device is located. A specific license tax must be paid which varies with the type of fishing device used. Minimum size limits are established for the taking of certain fish. Limits are established on the number of fish of certain species which are caught. Use of certain fishing nets is prohibited, and the lengths of nets and of other fishing structures are limited. Killing fish by means of explosives, drugs, or poisons is prohibited. Non-residents of the state are prohibited from fishing in the state's tidewaters in any manner other than with a line, rod, or pole. (Kelly-Florida)
W70-01771

DRAINAGE DISTRICTS.

Miss Code Ann secs 4579, 4580, 4606.1, 4606.3, 4606.5, 4618, 4619, 4625, 4641, 4673.5, 4673.7, (1956), as amended, (Supp 1968).

Descriptors: *Mississippi, *Drainage districts, *Land reclamation, *Irrigation, Legislation, Administrative agencies, Wetlands, Drainage, Controlled drainage, Surface drainage, Drainage systems, Drainage water, Soil conservation, Marsh management, Laterals, Outlets, Water management (Applied), Canals, Channels, Ditches, Levees, Diversion structures, Conduits, Water resources development, Water conservation, Compensation, Benefits, Cost-benefit theory, Irrigation water, Irrigation practices, Multiple-purpose projects.
Identifiers: *Federal-state cooperation, Penalties.

Drainage districts may be organized to reclaim by a system of drains, ditches, watercourses and levees wet or overflowed lands for agricultural or sanitary purposes. Procedures for organizing such districts are provided. Districts: (1) may construct or improve drains and ditches, tile drains, and natural water-courses as necessary; (2) may construct and operate works for the impoundment, diversion, flowage, and distribution of waters for beneficial use; (3) may make assessments, issue bonds, or contract with owners for the beneficial use of projects; and (6) may cooperate with federal projects where possible. Existing districts have the powers: (1) to take necessary measures for the prevention of erosion, floodwater and sediment damage; (2) to further the conservation, development, utilization and disposal of water; and (3) to adopt necessary regulations. Connecting districts must pay compensation for the use of another district's drain outlets. Procedures are established for crossing railroads with canals and for payment of damages. Injuring or impairing the usefulness of drains is a misdemeanor and punishable under the act. Water in drainage canals may be used for irrigation of farm lands so long as the primary purpose of the canals is not impaired. (Douberley-Florida)
W70-01772

POTOMAC RIVER COMPACT.

Va Code Ann secs 28.1-203, 28.1-203.1, 28.1-227 (1969).

Descriptors: *Virginia, *Maryland, *Interstate compacts, *Water resources development, Interstate commissions, Fish management, Commercial fish, Commercial fishing, Administrative agencies, Legislation, Legal aspects, Regulation, State governments, State jurisdiction, Grants, Permits, Shellfish, Investigations, Taxes, Tidal waters, Supervisory control (Power), Oysters, Clams.
Identifiers: Potomac River.

The purpose of the compact is to aid in conserving fishery resources in the tidewater portion of the Potomac River between Maryland and Virginia. The Potomac River Fisheries Commission is hereby created and is given jurisdiction over a specified geographical area encompasssing certain waters of the Potomac River. The Commission may reseed and replant oyster bars as necessary, regulate type and size of all species of finfish and shellfish that can be caught within its jurisdiction, conduct research related to fishery conservation, and regulate by license the persons who may take fish or shellfish and the equipment that may be used. The Commission is authorized to receive grants and contributions made for its general purposes. It may cooperate with other state agencies in carrying out its research. The Commission may impose inspection taxes on oysters taken from its jurisdiction. The statute contains provisions for review of Commission regulations and for enforcement of these regulations and associated state laws. Existing state laws and private rights shall remain in force, except as later altered by proper acts of the Commission. The Commission may regulate and tax the dredging of soft shell clams. (Kelly-Florida)
W70-01773

WATER PRIORITY RIGHTS AND THEIR EFFECT ON FARM PLANNING IN THE SAN CARLOS IRRIGATION AND DRAINAGE DISTRICT IN CENTRAL ARIZONA,

Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 03F.
W70-01814

THE GEOGRAPHICAL BACKGROUND OF THE JORDAN WATER DISPUTE.
For primary bibliographic entry see Field 06B.
W70-01833

TAKING ROAD MATERIALS FROM STREAMS, RIVERS, AND WATERCOURSES.

Va Code Ann sec 33-69 (Supp 1968).

Descriptors: *Virginia, *Road construction, *Construction materials, *River beds, Legislation, Highways, Roadbanks, Rivers, Streams, Streambeds, Beds, Ownership of beds, Rocks, Gravels, Sands, Eminent domain, Condemnation, Easements, Right-of-way.

Before removing materials from streams, rivers, or watercourses for use on public roads, the State Highway Commissioner must submit a plan for removal to the Marine Resources Commission. After receiving the concurrence of the Commission of Fisheries, the Commissioner may take materials from watercourses, the beds of which are owned by the state. He may acquire by condemnation all property, rights, and easements necessary to obtain and use such materials. (Douberley-Florida)
W70-01914

INDIAN HUNTING AND FISHING RIGHTS.
Geo Wash L Rev, Vol 32, No 3, p 504-532, Mar 1964. 29 p, 139 ref.

Descriptors: *Fishing, *Hunting, *Relative rights, *Federal government, Water utilization, State governments, Ownership of beds, Water rights, Land tenure, Permits, Judicial decisions, Riparian land, Riparian rights, Grants, Legal aspects, Wildlife conservation, Condemnation, Compensation.
Identifiers: Indian reservations.

The ownership of a reservation by an Indian tribe carries with it the right to hunt and fish within the reservation. The beds of waters adjacent to an Indian reservation may be construed to be included within the reservation regardless of an absence of express grant; this is contrary to normal conveyance of riparian land by the United States in that conveyance of submerged beds usually must be express. Indian tribes have obtained additional hunting and fishing rights through express treaty grants and where reservations do not exist, through their status as aboriginal users. Normally such rights are tribally owned and cannot be taken by the government without just compensation. After reviewing cases concerning attempted federal and state regulation of Indian hunting and fishing rights, the author concludes that three schools exist: that the Indians need not be licensed, but their rights are not superior to those of any private person; that the government can regulate Indian rights only to the extent that adequate conservation cannot be achieved by any other means; and that Indian hunting and fishing rights are not subject to state regulation. The author favors the second school. (Kelly-Florida)
W70-01930

PORT MANAGEMENT GENERALLY.

Va Code Ann sec 62.1-163, 1968.

Descriptors: *Virginia, *Port authorities, *Harbors, *Local governments, Industries, Administration, Legislation, Management, Cities, Compensation, Salaries, Administrative agencies, Legal aspects, Regulation, Jurisdiction, State jurisdiction, Personnel, Employment.

The governing body of any city having a port may create such agencies, appoint such agents, and employ such persons as may be required for the orderly and effective management of such port and its harbor. The circuit court of the county of Northumberland shall appoint an agent for the port of Needville. The appointing authority may prescribe for such agents and agencies such terms of office, titles, authorities, duties, fees, and compensation not inconsistent with law as it may deem appropriate, and may require from each person so appointed a fidelity bond. All controversies arising between or among agents, agencies, authorities, or commissions of two or more ports shall be referred to the Virginia State Ports Authority which shall resolve every such controversy in the best interests of the Commonwealth as a whole. Any party thereto shall have a right of appeal to the Supreme Court of Appeals. (Schram-Florida)
W70-01940

JURISDICTION AND OWNERSHIP OF COMMONWEALTH OVER OFFSHORE WATERS AND LANDS.
Va Code Ann sec 7.1-2 (1966).

Descriptors: *Virginia, *State jurisdiction, *Beds, *Oceans, Coasts, Legislation, International law, Federal jurisdiction, Legal aspects, Treaties, Boundaries, Ownership of beds, Seashores, International waters, Water law, Political aspects.
Identifiers: *Offshore waters.

The jurisdiction of this state extends to and over waters offshore from the coasts of this state as follows: (1) the marginal sea to its outermost limits as said limits may from time to time be defined or recognized by the United States by international treaty or otherwise; (2) the high seas to whatever extent jurisdiction therein may be claimed by the United States or to whatever extent recognized by the usages and customs of international law; and (3) all submerged lands, including the subsurface thereof, lying under said waters. The ownership of said waters and lands shall be in this state unless conveyed by instrument or operation of law. This shall not operate to impair the legislative jurisdiction by the United States over any area validly ceded by the state. Nothing in this section alters the geographic area to which any statute of this state applies if such statute specifies such area precisely in miles or by some other numerical designation of distance or position. No other statute, however, shall waive or relinquish the jurisdiction or ownership established herein. (Schram-Florida)
W70-01975

BOUNDARY LINE BETWEEN VIRGINIA AND DISTRICT OF COLUMBIA.

Va Code Ann sec 7.1-10 (1966), as amended, (Supp 1968).

Descriptors: *Virginia, *District of Columbia, *Boundaries (Property), *State jurisdiction, Federal jurisdiction, Surveys, Erosion, High water mark, Legislation, Legal aspects, State governments, Landfills, Excavation, Taxes, Oil, Channels, Tributaries.
Identifiers: Coast and geodetic survey.

Pursuant to several federal acts, the boundary line between the District of Columbia and Virginia is established and declared to be binding by the State of Virginia. Said boundary line is described in detail. Concurrent jurisdiction over certain areas is established. The United States Coast and Geodetic Survey is authorized to survey and mark said boundary line. The boundary line begins at a point where the northwest boundary of the District of Columbia intercepts the high-water mark on the Virginia shore of the Potomac and follows the present mean high-water mark. Whenever said high-water mark on the Virginia shore is altered by fills, excavations, alluvion, or erosion, the boundary shall follow the new mean high-water mark. Whenever the location of the pierhead line along the Alexandria waterfront is altered, the boundary follows the new location of the pierhead line. (Schram-Florida)
W70-01982

RIGHT OF RAILROADS TO OCCUPANCY OF PASS OR DEFILE AND TO CROSS WATERCOURSES.

Va Code Ann secs 56-359, 56-362 (1969).

Descriptors: *Virginia, *Railroads, *Valleys, *Bridges, Legislation, Channels, Streams, Rivers, Navigable waters, Canals, Navigation, Navigable rivers.

No railroad company having a right to construct its road through any narrow defile of any creek or river valley shall have the right to exclusive occupance of such defile. When a railroad line is so located, no other railroad company shall obstruct the line first constructed, but it may be necessary to allow other companies use of the line. A railway may cross any canal, navigable stream, or watercourse, but not so as to unreasonably impede the navigation or use thereof. (Douberley-Florida)
W70-01992

SHORE DEVELOPMENT AND PRESERVATION.
R I Gen Laws Ann secs 46-3-2 thru 46-3-6 (1956), as amended, (Supp 1968).

Descriptors: *Rhode Island, *Beach erosion, *Shore protection, Coastal structures, Coastal engineering, Harbors, Ocean waves, Waves (Water), Beaches, Real property, Local governments, Coasts, Shore-line cover, Surf, Tides, Storms, Rivers, Investigations, Legislation, Legal aspects, Erosion control, Financing, Shores.
Identifiers: Storm damage.

The legislature intends to assist municipalities, by cooperative means, in protecting and preserving beach areas which are vulnerable to storm damage from erosion and damage from the elements. The Division of Harbors and Rivers is designated as the shore erosion authority for the state for the purpose of cooperating with the federal government. The Division shall conduct investigations of the state's shore line, harbors, and rivers and shall devise economical and effective methods and works for preventing and correcting beach erosion and resulting damage to public and private property. Open beach areas subject to loss of material through high waves or strong currents or beach areas vulnerable to storm damage because of geographical location are classed as exposed beach areas. Limits of the areas are in geographical, not political, terms. The Division of Harbors and Rivers within the State Department of Public Works, upon municipal application, provides two-thirds of the cost of acquisition of exposed beach areas. (Kelly-Florida)
W70-01997

FINANCING AND ACQUIRING LAND FOR BEACH EROSION CONTROL.

R I Gen Laws Ann secs 46-3-11 thru 46-3-18, 43-3-20, (1956), as amended, (Supp 1968)

Descriptors: *Rhode Island, *Beach erosion, *Financing, *Shore protection, Land tenure, Local governments, Harbors, Rivers, Construction costs, Coastal structures, Shore-line cover, Tides, Cost sharing, Administration, Cost repayment, Project planning, Compensation, Cost allocation, Legislation, Legal aspects, Erosion control.

Bonds may be issued by a municipality for the purpose of financing its share of the cost of acquiring land and of constructing or installing structures approved for the control of beach erosion. The municipality may secure repayment of such construction costs by assessments against property benefited. The assessments are made against property specially benefited by the construction of erosion control works and are made proportionately among affected landowners. All land is acquired in the name of the state. Payment therefor is made by the state, subject to municipal reimbursement. Title to the land is then transferred to the municipality, and the land is dedicated to the public

use. The Chief of the Division of Harbors and Rivers represents the state in dealing with the federal government in regard to financial assistance for beach erosion control works. (Kelly-Florida)
W70-01998

WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-02002

WEATHER MODIFICATION: LAW AND ADMINISTRATION,
Colorado Univ., Boulder.
For primary bibliographic entry see Field 03B.
W70-02028

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION OF YELLOWSTONE RIVER: VOLUME 1 - BILLINGS METROPOLITAN REGION, MONTANA,
Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 04A.
W70-01681

FLOOD PLAIN INFORMATION, KENAI RIVER, ALASKA.
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 04A.
W70-01682

FLOOD PLAIN INFORMATION, SHENANDOAH RIVER, CLARKE COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W70-01683

REGIONAL CONSIDERATION OF FLOOD PLAIN PLANNING,
Bi-State Metropolitan Planning Commission for Scott County, Iowa and Rock Island County, Ill.
For primary bibliographic entry see Field 06B.
W70-01837

TECHNIQUES FOR DEVELOPING A COMPREHENSIVE PROGRAM FOR FLOOD PLAIN MANAGEMENT,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 06B.
W70-01838

MAN SHOULD MANAGE THE FLOOD PLAINS,
For primary bibliographic entry see Field 06B.
W70-01839

6G. Ecologic Impact of Water Development

MAN AND NATURE AT ODDS IN THE DELTA,
Louisiana State Univ., Baton Rouge.
Joseph D. Martinez, and Clarence O. Durham, Jr.
Environ Sci and Technol, Vol 3, No 12, p 1252-1257, Dec 1969. 6 p, 8 fig, 4 photo, 5 ref.

Descriptors: *Mississippi River, *River training, *Flood control, *Environmental effects, Ecology, Environment, Social aspects, Legal aspects, Geomorphology, Habitats, Hydrology, Wetlands.
Identifiers: *Mississippi River channel changes.

The history of the effects of management and control of the Mississippi River channel is briefly reviewed. A general principle to consider in modifying, regulating, or controlling large-scale geologic features or processes is to use the natural forces, so far as possible, to create a desired effect. For example: It is a natural tendency for a river like the Mississippi to meander. Attempts to rigidly maintain the position of its channel by the use of such controls as levees and revetments pit the engineer against the natural forces of the river. Cutoffs, spillways, newly constructed distributaries, and other similar works are compatible with natural morphological changes, however, and use the natural forces to advantage. The need for special consideration of regional factors in environmental planning and management is stressed. Such things as sociological and political characteristics and influences must be considered. (Knapp-USGS)
W70-01642

WATER POLLUTION IN ALASKA: PRESENT AND FUTURE,
Federal Water Pollution Control Administration, College, Alaska, Water Lab.
For primary bibliographic entry see Field 05B.
W70-01879

07. RESOURCES DATA

7A. Network Design

A NOTE ON RANDOM RAIN-GAUGE ERRORS,
Otago Univ., Dunedin (New Zealand).
P. Hutchinson.
J Hydrol (New Zeal), Vol 8, No 1, p 8-10, 1969. 3 p, 1 fig, 1 tab, 1 ref.

Descriptors: *Rain gages, *Calibrations, *Statistical methods, Data collections, Estimating, Quality control, Sampling, Measurement.
Identifiers: New Zealand, Rain gage error.

By using 12 standard rain gages on a small site, the random errors of rain-gage measurements were assessed both for individual storms and for monthly totals. It is shown that random errors can be considerable even without taking into account known systematic errors. For individual storms, the standard deviation increases with the mean rainfall value for the 12 gages, while the coefficient of variation is independent of the mean. The monthly values for the three months studied have standard deviations of the same order as the individual storms, but with lower--almost negligible--coefficients of variation. (Knapp-USGS)
W70-01693

7B. Data Acquisition

RESOLVING TIME, MASS ABSORPTION COEFFICIENT AND WATER CONTENT WITH GAMMA-RAY ATTENUATION,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 02G.
W70-01652

EVALUATING THE USE OF Na, Ca, AND DIVALENT CATION ELECTRODES IN SOME SOIL EXTRACTING SOLUTIONS,
Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 02G.
W70-01653

CONDUCTIVITY INSTRUMENTATION FOR IN SITU MEASUREMENT OF SOIL SALINITY,
Burr-Brown Research Corp., Tucson, Ariz.; and Arizona Univ., Tucson.
For primary bibliographic entry see Field 02G.
W70-01657

HYDRODYNAMIC STUDIES FOR ELECTRODIALYSIS,
McDonnell Douglas Astronautics Co., Newport Beach, Calif.
For primary bibliographic entry see Field 03A.
W70-01672

THE RECENT HISTORY OF THE INDUS,
Hunting Technical Services Ltd., Boreham Wood (England).
D. A. Holmes.
Geographical Journal, Vol 134, No 3, p 367-382, 1968. 5 fig, 12 ref.

Descriptors: *Mapping, *Aerial photography, *History, *Rivers, *Hydrography, Topography, Soil surveys, Arid climates, Channels.
Identifiers: *Indus River, *West Pakistan.

The author discusses evidence available from aerial photo interpretation as to probable courses over the past 2,000 years of the Indus River through the former province of Sind, West Pakistan, located in the western Thar Desert. The photo technique was found particularly useful in such an arid zone where alluvial patterns are not quickly changed by vegetation and soil formation processes. Maps are presented showing the present course and probable former courses. Changes since the 18th century are well documented. Probable locations and effects on current settlements are discussed for the historical periods of Greek, Arab, and Muslim occupation. Over the centuries the coastline has shifted many miles southward and into the Arabian Sea. Chronology of the different courses has also proven useful in understanding distribution of soils and non-saline ground water suitable for irrigation. (Crouse-Arizona)
W70-01804

THEORY AND EXPERIMENT IN CANAL SEEPAGE ESTIMATION USING RADIOISOTOPES,
Bhabha Atomic Research Center, Bombay (India). Isotope Div.
For primary bibliographic entry see Field 02G.
W70-01858

THE USE OF SCHLUMBERGER AND EQUATORIAL SOUNDINGS IN GROUNDWATER INVESTIGATIONS NEAR EL PASO, TEXAS,
Geological Survey, Denver, Colo.
Adel R. Zohdy.
Geophysics, Vol 34, No 5, p 713-728, Oct 1969. 16 p, 11 fig, 30 ref.

Descriptors: *Electrical studies, *Geophysics, *Exploration, *Groundwater, *Subsurface investigations, Surveys, Seismic studies, Texas, Electrical resistance, Instrumentation, Permeability, Aquifers, Water quality, Saline water-freshwater interfaces, Aquicludes.
Identifiers: Groundwater prospecting, Electrical soundings.

Electrical soundings using the symmetric AMNB Schlumberger and the bipole-dipole equatorial arrays were made along 2 profiles near El Paso, Texas, in support of a groundwater exploration program which included seismic refraction and gravity surveys. Electrode spacings reaching 12,000 ft allowed exploration to depths of about 7000 ft. Geoelectrical information on the subsurface materials was augmented by sounding with the bilateral equatorial configuration and by transforming Schlumberger curves into dipole-polar sounding curves. The bilateral equatorial sounding curves were useful for detecting the direction of dip of highly resistive bedrocks whereas transformed sounding curves were used to evaluate the average longitudinal resistivity and depth, to the 'electric basement.' The interpretation of distorted sounding curves illustrates the need for careful analysis in processing electrical prospecting data obtained in complex geologic conditions. The interpretation of a combined Schlumberger-equatorial sounding curve, which did not agree with seismic refraction data, was shown to be correct by data from a test well drilled to a depth of 4363 ft. Information was collected on the depth to fresh-water-salt-water interfaces and on the depth to highly resistive impervious bedrocks. (Knapp-USGS)
W70-01859

OPTIMIZING SEDIMENT SAMPLING PLANS,
Washington Univ., Seattle. Dept. of Oceanography.
J. C. Kelley, and D. A. McManus.
Marine Geol, Vol 7, No 5, p 465-471, Oct 1969. 7 p, 2 fig, 1 tab, 13 ref. Contract NONR-477 (37), Prog NR 083 012, ONR Contract AT (45-1)-1725 (Ref RLO-1725-125) AEC.

Descriptors: *Sampling, *Sediments, *Optimization, Statistical methods, Probability, Test procedures, Dredging, Particle size, Sedimentology, Marine geology.
Identifiers: Sampling optimization.

Sediment sampling at sea is a costly undertaking and inefficiency and redundancy must be minimized. Conversely, it is essential that the sampling density is high enough to obtain sufficiently reliable estimates of the variables of interest. In order to formalize these goals, an analysis of nine textural variables measured on samples from 450 stations on the continental shelf was made. A criterion for sufficient reliability was determined and optimal sampling plans were derived on the basis of this criterion. In an example of the analysis on one of the variables, mean phi size, the results indicate that even with optimal allocation of effort, much more extensive sampling is required for the resolution usually sought. (Knapp-USGS)
W70-01870

AERIAL INFRARED SURVEYS AT THE GEYSERS GEOTHERMAL STEAM FIELD, CALIFORNIA,
Geological Survey, Washington, D.C.
R. M. Moxham.
In: Geol Surv Res 1969, Prof Pap 650-C, p C106-C122, 1969. 17 p, 16 fig, 2 tab, 11 ref.

Descriptors: *Steam, *Thermal springs, *California, *Geothermal studies, *Infrared radiation, Aerial photography, Remote sensing, Thermal radiation, Heat flow, Temperature, Thermal conductivity.
Identifiers: *Steam wells, *Geysers Geothermal Area (Calif), Infrared photography.

An infrared radiance pattern on aerial infrared images of The Geysers area extends beyond the present (1968) northwest limit of steam production, and suggests slightly elevated surface temperatures. The radiance zone seems to coincide in part with a mapped fault, across which a surface temperature difference was measured. The principal high-temperature zones are bounded at the surface on the southwest by thermal lineaments, suggesting some corresponding structural control. The abnormal radiance at The Geysers is restricted to hydrothermal alteration zones and other local features. No evidence was found of a regional geothermal anomaly at the surface in The Geysers area, within the detection limit of the equipment used in this survey. (Knapp-USGS)
W70-01894

COMPARATIVE RESULTS OF SEDIMENT SAMPLING WITH A SURFACE SAMPLER AND DEPTH-INTEGRATING SAMPLERS,
Geological Survey, Austin, Tex.
Clarence T. Welborn.
In: Geol Surv Res 1969, Prof Pap 650-C, p C184-C187, 1969. 4 p, 6 fig, 4 ref.

Descriptors: *Sediment load, *Sampling, *Equipment, *Data processing, *Calibrations, Bed load, Suspended load, Sediment transport, Statistical methods.
Identifiers: Depth-integrating sediment samplers, Surface sediment samplers.

An investigation was made to determine the possibility of correlating sediment data from samples collected with a surface sampler with data from samples collected with depth-integrating samplers. A coefficient can be computed for sediment concentrations collected with a surface sampler from streams that carry small amounts of sand. It was not possible to compute a single coefficient that could be applied to the samples collected with a surface sampler from streams carrying a significant sand load. (Knapp-USGS)
W70-01897

FLOW-THROUGH SAMPLING SYSTEM FOR SMALL BOATS OR ICE SHELTER,
Geological Survey, Washington, D.C.; and Geological Survey, Fort Wayne, Ind.
John F. Ficke, and Robert G. Lipscomb.
In: Geol Surv Res 1969, Prof Pap 650-C, p C209-C211, 1969. 3 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Sampling, *Water quality, *Chemical analysis, Streams, Lakes, Instrumentation, Laboratory tests, Water analysis.
Identifiers: Flow-through sampling system.

A simple pumping sampler and flow-through system have been assembled for making rapid nonrecording temperature, conductance, dissolved-oxygen, and pH measurements on lakes. The set of observations at a point can be completed in about 3 minutes. Measurements to a depth of 30 meters can be made from a small boat or a portable ice shelter. Tests show that the pumping system does not affect the concentration of dissolved gases in the water. (Knapp-USGS)
W70-01900

SIMPLIFIED PUMPING SAMPLER FOR SUSPENDED SEDIMENT,
Geological Survey, Sacramento, Calif.
Benjamin L. Jones.
In: Geol Surv Res 1969, Prof Pap 650-C, p C212-C214, 1969. 3 p, 3 fig, 1 ref.

Descriptors: *Sampling, *Suspended load, Turbidity, Streams, Lakes, Instrumentation, Laboratory tests, Water analysis, Sediments.
Identifiers: Suspended sediment sampler.

A simplified pumping sampler was developed for the collection of suspended-sediment samples from streams. The sampler has a capacity of 20 containers, and the interval between samples can be varied from 2 minutes to several hundred hours. The sampler consists of a pump, electronic controls, and a bottling mechanism. The low initial cost, small size, and ease of installation of the device make it suitable for incorporation into present data-collection programs. (Knapp-USGS)
W70-01902

CARBON-14 DATES OF GROUND WATER FROM A PALEOZOIC CARBONATE AQUIFER, SOUTH-CENTRAL NEVADA,
Geological Survey, Denver, Colo.; and Geological Survey, Washington, D.C.
D. B. Grove, Meyer Rubin, B. B. Hanshaw, and W. A. Beetem.
In: Geol Surv Res 1969, Prof Pap 650-C, p C215-C218, 1969. 4 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Radioactive dating, *Carbon radioisotopes, *Groundwater, *Carbonate rocks, *Nevada, Age, Groundwater movement, Sampling.
Identifiers: Carbon-14 groundwater dating.

Radiocarbon determinations were used to estimate the ages of groundwater from the Paleozoic aquifer underlying the Nevada Test Site and adjacent areas. A generally good correlation exists between the carbon-14 dates and the current hydraulic interpretations; but the aquifer is heterogeneous and is insufficiently defined to permit detailed predictions of groundwater velocities or flow patterns. (Knapp-USGS)
W70-01903

DETERMINATION OF THE BIOMASS OF AQUATIC PLANTS USING AN OPTICAL METHOD,
Water Pollution Research Lab., Stevenage (England).
M Owens, M. A. Learner, and P. J. Maris.
Journal of Ecology, Vol 55, No 3, p 671-676, 1967. 4 fig, 2 tab, 7 ref.

Descriptors: *Biomass, *On-site data collections, *Aquatic plants, *Optical properties, Weeds, Calibration, Herbicides, Density, Light intensity, Attenuation, Distribution patterns, Eutrophication, Lakes, Analytical techniques, Standing crop, Productivity, Light penetration.
Identifiers: Elodea canadensis, Berula erecta, Hippuris vulgaris, Callitriche, Ceratophyllum demersum, Myriophyllum, Potamogeton lucens, Potamogeton perfoliatus, Depth effects, Beds (Plants), Ranunculus pseudofluitans.

Cropping methods, used to determine the biomass of aquatic macrophytes, are tedious, particularly when the depth of water is so great that operations from a boat or by diving are necessary. Furthermore, it is sometimes desirable to determine biomass without removing the plants. A previously described method is applied by authors to determine quantitative distribution of aquatic plants by underwater light distributions. Vertical attenuation coefficients for several aquatic plants were determined in the field and compared with those obtained using laboratory procedures. Estimates of plant biomass obtained by cropping with those using this optical method agree closely. Three distribution patterns of biomass of plants at seasonal maximum are discernible. Berula and Hippuris are fairly uniformly distributed throughout the water column; Ranunculus and two Potamogeton species are near the surface, and greatest proportions of Ceratophyllum and Elodea are in the lower half of the column. A detailed study of herbicide application effects in an experimental lake, which contained biomass of Elodea canadensis, was determined on six dates by this optical method and could not have been accomplished using conventional cropping procedures. (Jones-Wisconsin)
W70-01931

USE OF MODIFIED DIURNAL CURVES FOR THE MEASUREMENT OF METABOLISM IN STANDING WATER,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-01941

7C. Evaluation, Processing and Publication

GEOLOGY AND GROUND WATER RESOURCES OF BURKE AND MOUNTRAIL COUNTIES: PART 2, GROUND WATER BASIC DATA,
Geological Survey, Washington, D.C.
C. A. Armstrong.
N Dak Geol Surv Bull 55 and N Dak State Water Comm County Ground Water Studies 14, 1969. 282 p, 2 fig, 2 plate, 5 tab, 13 ref.

Descriptors: *Data collections, *Hydrologic data, Water wells, Water quality, Aquifers, Water levels, Water table, Water yield.
Identifiers: Burke County (N Dak), Mountrail County (N Dak).

Basic data are compiled to use to determine the location, extent, and nature of aquifers, to evaluate groundwater occurrence and movement, to estimate potential well yields, and to determine water quality in Burke and Mountrail Counties, North Dakota. Tabulated data include information on 2100 wells, 58 springs, 63 observation wells, and 504 water chemical analyses. (Knapp-USGS)
W70-01684

THE ESTIMATION AND OCCURRENCE OF AGRICULTURAL DROUGHT,
Department of Agriculture, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 03F.
W70-01687

ESTIMATING COSTS OF AERIAL SURVEYS,
Kansas State Univ., Manhattan. Dept. of Civil Engineering.
Antonio M. Aguilar.
Civil Eng, Vol 39, No 10, p 70-73, Oct 1969. 4 p, 2 fig, 6 tab, 2 ref.

Descriptors: *Photogrammetry, *Surveys, *Mapping, *Cost analysis, *Estimated costs, Estimating, Forecasting, Aerial photography, Geological surveys, Photography, Terrain analysis.
Identifiers: Aerial photography costs.

Increasing numbers of project engineers without specialized training in photogrammetry are facing the task of preparing cost estimates of mapping projects. A need exists to provide those engineers with a simple but acceptable accurate cost estimating system. A system is described which renders accurate results for most of the mapping projects that an engineer faces, which is simple enough to compute the cost as a function of map scale, size of the area to be mapped and standardized mapping area conditions. Formulas, tables, and procedures are given to allow the engineer to estimate the maximum and minimum costs of an aerial survey. The system has been tested in 135 actual mapping projects prepared by six organizations, and in all cases predicted costs have been within an acceptable range of the actual costs. (Knapp-USGS)
W70-01698

OPTIMIZATION OF FLASH DISTILLATION PLANTS FOR SEA-WATER CONVERSION,
Haschinenfabrik Augsburg-Nuernberg A. G., Gustavsburg (West Germany).
B. Kunst.
Desalination 3, p 195-202, 1967. 9 fig, 2 ref.
Identifiers: *Computerized designs, *Economic evaluations, *Multistage flash distillation, Cost allocation, Dual-purpose plant, Energy costs, Product ratio, Programs (Computers).

To find an optimal solution for the design of a chemical process plant, all that is really required is an electronic computer of adequate size and speed and some detailed work which consists of disclosing the defining characteristics of the relevant function and in suitably controlling these. Unduly large programs, however, are difficult to handle and may not even be usable for lack of sufficient storage capacity and computing time. Hence, the planning of a plant must be carried out in two stages. In the first stage a series of optimum plant data is determined by means of a basic design procedure, an approximate estimation, and a minimum-seeking subprogram. In the second stage these data are used as initial values for the detailed design and cost estimation.
W70-01705

08. ENGINEERING WORKS

8A. Structures

SOME BASIC ASPECTS OF THE FLASH DISTILLATION PROCESS,
Heriot-Watt Univ., Edinburgh (Scotland).
For primary bibliographic entry see Field 03A.
W70-01712

EXERGY LOSSES IN A FLASH EVAPORATOR,
Technische Hogeschool, Delft (Netherlands).
For primary bibliographic entry see Field 03A.
W70-01713

DESIGN OF A 250-MGD VERTICAL-TUBE EVAPORATOR FOR SEAWATER DESALTING,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 03A
W70-01725

COUNTY PORT AUTHORITY.
For primary bibliographic entry see Field 06E.
W70-01762

THE ORIGIN AND SPREAD OF QANATS IN THE OLD WORLD,
Texas Univ., Austin, Tex.
For primary bibliographic entry see Field 04B.
W70-01830

PAPER: (NAVIGABLE WATERWAYS BANK PROTECTION) (in French),
Behorde fuer Wirtschaft und Verkehr, Hamburg (West Germany).
For primary bibliographic entry see Field 06B.
W70-01841

PAPER: (NAVIGABLE WATERWAY BANK PROTECTION) (IN FRENCH),
Ghent Rijksuniversiteit (Belgium).
For primary bibliographic entry see Field 06B.
W70-01842

THE ROVI REACTOR FOR DESALINATION OF SEA WATER - DESIGN AND INSTALLATION CRITERIA,
Montecatini Edison, Milan (Italy).
For primary bibliographic entry see Field 03A.
W70-01962

8B. Hydraulics

REVERSE AND DIRECT RESERVOIR ROUTING METHOD SETS HIGHWAY GRADE,
Ministry of Public Works, Caracas (Venezuela).
For primary bibliographic entry see Field 04C.
W70-01660

DIVERSION BY LAKE PIERCING, SNETTISHAM PROJECT,
Corps of Engineers, Anchorage, Alaska.
Thomas E. Munsey.
Civil Eng, Vol 39, No 10, p 48-52, Oct 1969. 5 p, 2 fig, 3 photo, 4 ref.

Descriptors: *Drainage, *Lakes, *Alaska, *Tunneling, *Diversion tunnels, Tunnels, Water levels, Tunnel hydraulics, Hydraulic structures, Tunnel design, Outlet works, Hydroelectric plants, Dams, Reservoir design, Reservoir construction.
Identifiers: Lake piercing.

The Norwegian method of lake piercing, well known throughout northern Europe, is being used in the Snettisham Project in southeastern Alaska to temporarily lower the water surface of a lake 130 ft below its natural level. After the surface drops, a power intake works will be constructed just above the low-water level, thus making 110,000 acre-ft of natural storage available for hydroelectric power production which would have been lost had a more conventional means of diversion been used. The method consists of driving a tunnel lakewards toward a point where an outlet is desired. A small rock plug is left to separate the tunnel and lake. After careful exploration and preparation, the plug is blasted through to drain the lake through the tunnel. A concrete plug will permanently stop flow in the tunnel when construction of the power works is completed. (Knapp-USGS)
W70-01661

HYDRODYNAMIC STUDIES FOR ELECTRODIALYSIS,
McDonnell Douglas Astronautics Co., Newport Beach, Calif.
For primary bibliographic entry see Field 03A.
W70-01672

DEVELOPMENT OF AN ANALYTICAL MODEL OF A FLASH STAGE - PART I,
Connecticut Univ., Storrs.
C. H. Coogan, Jr , D. A. Fisher, F. W. Gilbert, and H. L. Ornstein.
OSW R and D Progr Rept No 364, July 1968. 69 p, 39 fig, 26 ref.
Identifiers: *Flash chambers, *Flow distribution, *Heat transfer, *Turbulent boundary layer, Development, Distillation processes, Evaporators, Flash evaporation, Flow distribution, Fluid dynamics, Fluid flow, Fluid mechanics, Heat balance, Thermodynamic analysis, Turbulence, Two-phase flow, Weirs.

Model proposed consists of (1) The entrance jet region - wherein a submerged wall jet from the entrance orifice spreads vertically with recirculation above the jet. A high degree of turbulence causes large values of thermal conductivity in the vertical heat flow which evaporates the liquid at the free surface, (2) The central portion - wherein the velocity profile adjusts from a maximum at bottom to a maximum near the top, (3) The exit region - wherein the fluid is accelerated for entrance into the following stage. The major vertical heat transfer occurs in region (2). A typical boundary layer occurs at the channel bottom. Jet induced turbulence predominates. In region (2) at the liquid surface vapor is generated at the greatest rate. Turbulent thermal conductivity approximates 300,000 btu/hr ft deg F. Tentative relations for turbulent thermal conductivity are proposed. Fluctuations due to the turbulence is suggested as cause of large values of conductivity. Calculations based on AFM-CUNO Millstone Point laboratory test data.
W70-01723

STUDY OF TWO-PHASE METASTABLE FLOW,
Foster Wheeler Corp., Carteret, N.J.
For primary bibliographic entry see Field 03A.
W70-01753

DRAINAGE DESIGN THEORY AND PRACTICE,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
For primary bibliographic entry see Field 02A.
W70-01877

HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY,
Waterloopkundig Laboratorium, Delft (Netherlands).
Gerrit Abraham.
Journal of the Hydraulics Division, ASCE, Vol 91, No. HY4, Proc Paper 4411, p 139-154, July 1965. 16 ref, 6 fig.

Descriptors: *Jets, *Density, *Diffusion, Turbulence.
Identifiers: *Stagnant fluid.

The purpose was to study theoretically the influence of the density difference between a jet and the surrounding fluid on the diffusion caused by a circular horizontal submerged turbulent jet on the basis of the similarity principle. A theoretical solution is given on the basis of the assumption that the local variation of density in the jet is small in comparison with the density of the ambient fluid. Only three dimensional circular horizontal jets were considered in this study, and also only turbulent jets, so the influence of viscosity was not considered. Conclusions were: (1) The theoretical results show how the coordinates of the axis of the jet and the rate of mixing, and the velocity at the axis of the jet depend on the initial density difference between the jet and the stagnant ambient fluid and on the velocity of the jet when it issues from a nozzle. (2) The theoretical solution agrees fairly well with experimental data available in literature. (Guerrero-Vanderbilt)
W70-01912

TWO DIMENSIONAL REATTACHING JET FLOWS INCLUDING THE EFFECTS OF CURVATURE ON ENTRAINMENT,
Cambridge Univ. (England). Dept. of Engineering.
R. A. Sawyer.
Journal of Fluid Mechanics, Vol 17, Part 4, p 481-498, 1963. 8 fig, 16 ref.

Descriptors: *Jets, *Mixing, Diffusion.
Identifiers: *Entrainment, Recirculation.

The purpose of this study was to modify a previous analysis for predicting the average pressure and length of the region of recirculating flow enclosed by a low-speed turbulent jet, issuing parallel to a flat plate, taking into account the different rates of entrainment by the two edges of the curved jet, the initial mixing region and the pressure forces near reattachment. There is improved correlation between theory and experiment. The analysis was applied to the flow due to a jet emerging at an angle to a flat plate, and gives good prediction of the length and average pressure of the recirculation region for a particular value of an entrainment ratio parameter. Some conclusions were (1) A first order mixing length theory indicates that the effect of different entrainment rates at the two edges of a curved jet does not lead to jet velocity profiles that are substantially different from those of a plane jet. (2) Curvature was found to have a considerable effect on the entrainment properties of jets. (Guerrero-Vanderbilt)
W70-01917

THE DISPERSION OF MARKED FLUID IN TURBULENT SHEAR FLOW,
Cambridge Univ. (England). Cavendish Lab.
J. W. Elder.
Journal of Fluid Mechanics, Vol 5, Part 4, p 544-560, 1959. 7 fig, 14 ref.

Descriptors: *Open channels, *Diffusion, *Turbulent flow.
Identifiers: *Dispersion, *Marked fluid, Shear flow.

This paper describes the application of the analysis used by Taylor (1954) and based on the Reynolds analogy, to the case of the diffusion of marked fluid in turbulent flow in an open channel. The coefficient of longitudinal diffusion arising from the combined action of turbulent lateral diffusion and convection by the mean flow is computed to be 5.9 uh, where h is the depth of fluid and u the friction velocity. This is in agreement with the experiments carried out in the 14-inch water flume of the Engineering Laboratory, Cambridge. The working section was 10 feet long, rectangular in section and inclined at 0.046 deg to the horizontal. The experiments were limited to a depth of 1.0 to 1.5 cm, corresponding to a Reynolds number range of 2300 to 4500. The lateral diffusion coefficient was found by experiment to be 0.23 uh, which is three times larger than the value obtained by the assumption of isotrophy. The same analysis can be used to describe the longitudinal dispersion of discrete particles, both of zero buoyancy and of finite buoyancy, and comparison was made with observations by Batchelor, Binnie and Phillips (1955) and Binnie and Phillips (1958). (Guerrero-Vanderbilt)
W70-01919

MODEL SIMULATION OF VERTICAL MIXING IN STRATIFIED FLOWING WATER,
University of Strathclyde, Glasgow (Scotland).
D. I. H. Barr.
The Engineer, Vol 215, No 5587, p 345-352, Feb 22, 1963. 7 fig, 2 tab, 30 ref.

Descriptors: *Models studies, *Stratified flow, *Mixing, Thermal pollution.
Identifiers: *Heat dissipation.

A study of the basis of design of heat dissipation models was discussed. An empirical approach to the determination of the vertical exaggeration in such models was made, the basis of the method being the use of a Keulegan type congruency diagram for lock exchange flow in a wide channel. An introduction box with a fairing was fitted across a 1.5 ft wide plume to produce a thermally stratified flow in the flume downstream of the box with a depth controlled to be 0.625 ft using a downstream weir gate. The flows selected were 0.446, 0.223, 0.1115, 0.056, 0.0070 and 0.0167 cusecs. An in situ temperature measurement system based on thermopile was used. Small density differences were produced by temperature variations in the range from 60 deg F to 100 deg F. A 4.5 inch wide flume was also used as a quarter scale model of the larger flume. Conclusions were: (a) In some cases involving flowing water, the internal differential movements are dominant and the standard Froude criterion need not be applied strictly. (b) The hydraulics Research Station's method (1960) of determining exaggeration in heat dissipation models is thought to be dangerous. (c) When the congruency diagram for lock exchange underflow in a wide channel is extended, more accurate assessments of vertical exaggeration will be possible. (d) The possible effect of weather conditions has been neglected and the effects should be investigated. (Guerrero-Vanderbilt)
W70-01920

THE BUOYANT MOTION WITHIN A HOT GAS PLUME IN A HORIZONTAL WIND,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
G. T. Csanady.
Journal of Fluid Mechanics, Vol 22, Part 2, p 225-239, 1965. 4 fig, 20 ref.

Descriptors: *Winds, *Buoyancy, *Turbulence.
Identifiers: *Smoke plume, *Rayleigh number.

The purpose of this study was to elucidate the behavior of a buoyant mass of fluid, injected at a constant rate into a moderately strong horizontal wind. A smoke plume that has become nearly horizontal at some distance from the source, behaves much like a 'line thermal,' for which, using a perturbation method, a solution in laminar flow may be obtained, on the supposition that excess temperatures are small and buoyant movements slow, i.e. that the Rayleigh number of the problem is suitably low. In analogy with some other problems in turbulent flow and in turbulent diffusion, the laminar solution is then assumed to approximate what is observed in the turbulent case, provided that the rate of growth of the diffusing cloud is assessed realistically. The so-calculated pattern of streamlines in a cross section of the plume agrees qualitatively with the observed behavior of hot plumes and puffs, consisting of two vortex-like structures of opposite sense of rotation, lying on either side of the plume center. The bodily upward movement of the plume is found to depend critically on the rate of growth of the plume. Thus, when the plume diameter grows faster than linearly with distance, the plume tends to reach an asymptotic height. The small Rayleigh number criterion restricts the validity of the solution to 'weakly buoyant' plumes. (Guerrero-Vanderbilt)
W70-01926

DIFFUSER DESIGN FOR DISCHARGE TO A STRATIFIED WATER,
Danish Isotope Center, Copenhagen.
For primary bibliographic entry see Field 05G.
W70-01928

8C. Hydraulic Machinery

COMBINED SYSTEM FOR THE OPTIMUM SATISFACTION OF SIMULTANEOUSLY ARISING DEMAND FOR FRESHWATER AND ELECTRICAL POWER,
Hoterv, Budapest (Hungary).
L. Heller, and L. Szucs.
Preprint of Paper SM-113/16 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 13 p, 9 fig.
Identifiers: *Dual-purpose plant economics, *Economic evaluations, Distillation processes, Dual-purpose plant, Flowsheets, Freeze processes, Membrane processes, Multistage flash distillation, Thermodynamics, Turbines.

In areas of low electric power demand, e.g., on islands and in underdeveloped countries, the advantages of back-pressure power generation are often not fully utilized. A solution presented here is to use the unsaleable energy for desalting of seawater by processes requiring this type of energy (heat pump, freezing, electrodialysis, etc.). A method is presented by which the optimum combination of processes and equipment can be selected to supply the demand for fresh water and electricity in any given area under any established conditions. In some combined processes the generated mechanical-type energy can be used for desalting equipment directly without electric or other coupling, thereby lowering fresh water costs. The combined system makes possible full use of electric power capacity in low-load periods, producing storable fresh water. Several examples are given to illustrate this point. Multiflash and heat-pump combinations, especially multiflash and injector-type heat-pump combinations, are treated in detail.
W70-01708

THE CHARACTERISTICS OF DUAL PROCESS DISTILLATION PLANT COMBINING VAPOUR COMPRESSION AND MULTI-STAGE FLASH EVAPORATORS,
Atomic Energy Research Establishment, Winfrith (England).
For primary bibliographic entry see Field 03A.
W70-01710

THE STEAM-GENERATING HEAVY-WATER REACTOR IN DUAL-PURPOSE APPLICATIONS,
Atomic Energy Research Establishment, Winfrith (England).
S. Chambers.
Preprint of Paper SM-113/45 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 9 p, 4 fig, 5 ref.
Identifiers: *Dual-purpose plant, *Multistage flash distillation, *Nuclear energy sources, *Programs (Computers),Capitalized costs, Computerized designs, Energy sources, Feasibility study, Heavy-water/Boiling-light-water reactors, Water costs estimate, 0-50 MGD plant, 51-250 MGD plant.

Two separate computer programs were used to study the SGHWR in dual-purpose systems and cross-tube multistage flash evaporation plants. One program calculates the steam cycle flowsheet and uses the performance ratio in a costing routine for the reactor and evaporator. The other calculates the detailed flowsheet and plant geometry of a multistage flash plant and performs a thorough commercial costing. The computer programs themselves are not given. Systems were studied over a range of water outputs of 60 to 240 mgd and a range of net electrical outputs from 100 to 400 mw. Optimization was done of the basis of minimum total operating cost and the water costs were calculated based on a power credit appropriate to an equivalent single-purpose power-only plant. It is seen that the SGHWR is capable of achieving a production ratio in excess of 0.5 mgal/mwd when used in conjunction with a multistage flash evaporation plant with present technology. Estimated water costs at a load factor of 90% and 10% for range from 33 to 36 cents/1000 gal. Acid treatment of the feedwater adds about 2.9 cents/1000 gal to these costs.
W70-01711

GAS-TURBINE AND DIESEL-DRIVEN VAPOR-COMPRESSION DESALTING PLANTS,
Oak Ridge National Lab., Tenn.; and Office of Saline Water, Washington, D.C.
S. J. Senatore, and P. G. Tomalin.
IN Proc Western Water Power Symp, Los Angeles, Apr 1968. Western Periodicals, North Hollywood, Calif, 1968. p c-33-43, 2 fig, 4 ref.
Identifiers: *Gas turbines, *Multistage flash distillation, *Single-purpose plant, *Vapor compression evaporation, *Vertical tube evaporators, Distillation processes, Fixed charge rate, Flash evaporation, Single-purpose plant economics, Turbines, Vapor compressors, Water costs estimate, 0-50 MGD Plant.

A study was conducted at ORNL to determine the economic potential of a gas-turbine or diesel-engine drive for a vapor compressor and a vertical tube evaporator VTE for desalting seawater in the 1- to 10-mgd range. Commercial components were used for a 2-mgd diesel-driven plant and for a 5.7-mgd plant with a gas-turbine drive. The diesel-engine and gas-turbine drives for the vapor-compression, VTE concepts were found to have good potential for reducing distillation costs in water-only plants, with diesel engines most effective in the 1- to 5-mgd range. In the 5- to 10-mgd range, the gas-turbine-driven concept becomes attractive, with 20 of the fuel energy used in the vertical tube effects and 56 in the MSF evaporator. Water cost of the 2-mgd diesel-powered plant with 32/mbtu natural gas fuel is estimated at 65 cents/1000 gal, based on a fixed charge rate of 5.8. Corresponding water cost for a gas-turbine 5.7-mgd water-only plant is 57 cents/1000 gal. The advantage of the vapor-conpression, VTE system is in its economies of 25 lb product/1000 btu fuel without the necessity of using high brine temperatures or very low temperature differences. The engine drive is more economical than an electric drive because waste heat can be recovered efficiently.
W70-01724

RATIONALE FOR LOW-COST NUCLEAR HEAT AND ELECTRICITY,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 03A.
W70-01946

INTEGRATING DUAL-PURPOSE PLANT FOR POWER AND WATER PRODUCTION INTO AN EXISTING ELECTRICITY SUPPLY SYSTEM,
Electro-Watt Engineering Services Ltd., Zurich (Switzerland).
For primary bibliographic entry see Field 03A.
W70-01948

COMBINATION OF HIGH-TEMPERATURE REACTOR WITH A CLOSED-CYCLE GAS TURBINE AND DESALINATION PLANT,
Gutehoffnungshuete Sterkrade A.G., Oberhausen (West Germany).
For primary bibliographic entry see Field 03A.
W70-01949

THE SODIUM-COOLED FAST BREEDER REACTOR AS A HEAT SOURCE FOR DESALINATION PLANTS,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 03A.
W70-01950

PRESSURIZED-WATER REACTORS FOR NATURAL AND ENRICHED URANIUM,
Siemens A. G., Erlangen (West Germany).
For primary bibliographic entry see Field 03A.
W70-01952

TECHNICAL AND ECONOMIC ASPECTS OF MEDIUM-POWER PLANTS FOR THE COMBINED PRODUCTION OF ELECTRICAL POWER AND DESALINATED WATER, USING VULCAN REACTORS AND LTV UNITS (IN FRENCH),
Societe Belge pour l'Industrie Nucleaire, Brussels; and Universal Desalting Corp., New York.
For primary bibliographic entry see Field 03A.
W70-01953

ASPECTS IN DEVELOPING SEA WATER FLASH-DISTILLATION PLANT TO NUCLEAR-HEATED PLANT ON THE BASIS OF EXPERIENCE GAINED IN THE DESIGN, START-UP AND OPERATION OF SUCH INSTALLATIONS,
Atlas-Mak Maschinenbau G.m.b.H., Bremen (West Germany); and Fried-Krupp, Essen (West Germany). Zentralinstitut fuer Forschung und Entwicklung.
For primary bibliographic entry see Field 03A.
W70-01954

OPTIMUM BRINE HEATER STEAM TEMPERATURE ON MSF EVAPORATOR COUPLED WITH FOSSIL AND NUCLEAR FUELED POWER PLANTS,
GHH-Man Technik, Essen (West Germany).
For primary bibliographic entry see Field 03A.
W70-01956

HOT BRINE ENERGY STORE,
Aktiebolaget Atomenergi, Stockholm (Sweden).
For primary bibliographic entry see Field 03A.
W70-01957

SOME FEATURES REQUIRED OF NUCLEAR REACTORS FOR DUAL-PURPOSE WATER/POWER PRODUCTION,
United Kingdom Atomic Energy Authority, Risley (England).
For primary bibliographic entry see Field 03A.
W70-01959

PROGRESS IN NUCLEAR POWER AND DESALINATION,
Southern California Edison Co., Los Angeles.
For primary bibliographic entry see Field 03A.
W70-01961

THE ECONOMIC DEVELOPMENT OF NUCLEAR DESALTING PLANTS IN WATER AND POWER SUPPLY SYSTEMS,
Hawaii Univ., Honolulu; and Calif. Univ., Los Angeles.
For primary bibliographic entry see Field 03A.
W70-01963

HEAT SUPPLY TO A DESALTING UNIT BY AN ORGANIC NUCLEAR SINGLE-PURPOSE REACTOR (IN ITALIAN),
Comitato Nazionale per l'Energia Nucleare, Rome (Italy); and Montecatini Edison, Milan (Italy).
For primary bibliographic entry see Field 03A.
W70-01964

OPTIMIZATION STUDY ON THE COUPLING OF A LOW TEMPERATURE ROVI REACTOR WITH A DESALTING PLANT,
Bari Univ. (Italy); and Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
For primary bibliographic entry see Field 03A.
W70-01965

THE FUTURE ROLE OF BREEDER REACTORS IN UTILITY PLANNING,
Westinghouse Electric Corp., Pittsburgh, Pa.
For primary bibliographic entry see Field 03A.
W70-01966

COMPARATIVE ECONOMICS OF LARGE FOSSIL-FUELED VERSUS NUCLEAR GENERATING STATIONS,
Niagara Mohawk Power Corp., Syracuse, N.Y.
For primary bibliographic entry see Field 03A.
W70-01967

BRINE-HEATER LEAKAGE CONTROL PROBLEMS IN LARGE POWER DESALTING PLANTS,
For primary bibliographic entry see Field 03A.
W70-01968

8E. Rock Mechanics and Geology

INCREMENTAL STRESS UNDER A TWO-DIMENSIONAL ARTIFICIAL LAKE,
Alberta Univ., Edmonton. Dept. of Physics.
D. I. Gough.
Canadian J Earth Sci, Vol 6, No 5, p 1067-1075, Oct 1969. 9 p, 5 fig, 8 ref.

Descriptors: *Reservoirs, *Loads (Forces), *Stress, *Computer programs, Reservoir design, Structural stability, Geophysics, Seismology, Stress analysis, Faults (Geology), Fractures (Geology).
Identifiers: Reservoir-load tectonics, Dam safety.

Seismic activity has been induced by loading and possibly lubrication of faults in rocks underlying several artificial lakes. Such evidence of failure justifies study of incremental stress distributions produced by the filling of artificial lakes. In this paper two-dimensional lakes are considered. Equations are derived giving the incremental stress components due to a side of a water-filled trough of polygonal section in the surface of an elastic half-space. A computer program based on these equations is described. Distributions of stress parameters are shown for lakes of rectangular and isosceles triangular sections, and for a two-dimensional approximation of a section of the lake forming behind the Bennett Dam on the Peace River, British Columbia. (Knapp-USGS)
W70-01679

8F. Concrete

PAPER: (NAVIGABLE WATERWAYS BANK PROTECTION) (in French),
Behorde fuer Wirtschaft und Verkehr, Hamburg (West Germany).
For primary bibliographic entry see Field 06B.
W70-01841

PAPER: (NAVIGABLE WATERWAY BANK PROTECTION) (IN FRENCH),
Ghent Rijksuniversiteit (Belgium).
For primary bibliographic entry see Field 06B.
W70-01842

8G. Materials

PREVENTIVE FOR SCALING AND CORROSION OF FLASH EVAPORATORS,
Tokyo Electric Power Corp. (Japan); Mitsubishi Heavy Industries Ltd., Tokyo (Japan).
N. Noguchi, S. Sato, T. Imatake, T. Matsubara, and T. Hamada.
Preprint of Paper SM-113/12 Presented at IAEA Symp Nucl desalination, Madrid, Spain, Nov 18-22, 1968. 27 p, 8 fig, 6 ref.
Identifiers: *Corrosion control, *Heat transfer, *Operating experience, *Scale prevention, Corrosion, Corrosion problems, Corrosion tests, Feedwater treatment, Flash evaporation, Heat transfer improvements, Operational problems, Physical chemistry of scale, Scaling.

A 26,400 gpd flash evaporator pilot plant, designed and built to test its reliability in continuous operation, with particular attention to scaling and corrosion of heat transfer tubes and other equipment, has been in operation 7500 hrs. The experimental operation was carried out at temperatures up to 239 deg F, which is within the known solubility limits of calcium sulphate. Calcium carbonate and magnesium hydroxide scale were satisfactorily prevented by ph control. Data obtained on corrosion resistance of materials used in polluted seawater are (1) the variation in the characteristics of a pilot plant in relation to operating hours at various test conditions, (2) chemical composition of scale deposits at test conditions, i.e., top temperatures of 203 deg F to 239 deg F, mean ph values of 7.0 and 7.8 and concentration factor of 2.0, (3) the tendency of corrosion resistance in such materials as 90/10 cupronickel tubes, aluminum brass tubes, several ferric plates and steel plates coated with epoxy and rubber.
W70-01707

STUDY OF THE BEHAVIOUR OF VARIOUS MATERIALS IN SEA WATER UP TO 150 DEG C,
Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
G. Boisde, H. Coriou, L. Grall, C. Mahieu, and M. Pelras.
Preprint of Paper 113/23 Presented at IAEA Symp Nucl Desalination, Madrid, Spain, Nov 18-22, 1968. 25 p, 22 fig, 11 ref.
Identifiers: *Coatings, *Corrosion problems, *Dezincification, *Pitting (Corrosion), Aluminum alloys, Aluminum brasses, Copper alloys, Corrosion, Corrosion control, Corrosion tests, Fabrication materials, Titanium.

The behavior of metals, alloys and non-metal linings, chiefly in synthetic seawater (ASTM standard) at temperatures ranging from 100 to 150 deg C was studied. The tests were carried out in static conditions with particular attention to various types of local corrosion. After 1000 hours at 150 deg C in the presence of air there was (1) formation of deep pitting and transgranular cracks from the pits, as in the case of very low-carbon stainless steels of the type cr 18%, ni 10%, and cr 17%, ni 13%, mo 2.7%, and (2) considerable corrosion due to the crevice effect in titanium samples kept in contact with teflon components. Comparative tests at 100-150 deg C in air and in a vacuum made possible the study of effect of temperature and oxygen content on the dezincification of naval brass and aluminum brass, on the de-aluminization of single-phase and two-phase copper-aluminums (in the work-hardened and annealed state) and on the corrosion of 90/10 and 70/30 copper nickels. Some 30 commercial linings used for soft steel were tested in the liquid and vapor phases of seawater at 100, 125 and 150 deg C. The behavior of an epoxy resin with a polyamine hardener proved very encouraging. Experimental equipment developed for dynamic corrosion tests in natural seawater or in chlorinated solutions at temperatures up to 150 deg C was described. (In French)
W70-01709

CONDENSER TUBE MATERIALS FOR SEA-WATER SERVICE,
Naval Ship Research and Development Lab., Annapolis, Md. Annapolis Div.
R. B. Niederberger.
J Eng Power 88, p 410-14, 1966. 1 fig, 2 tab, 8 ref.
Identifiers: *Condensers, *Fabrication materials, *Tubing (Metal), Aluminum, Copper alloys, Corrosion, Corrosion tests, Erosion corrosion, Nickel alloys, Stainless steels, Titanium.

The results of a series of investigations to assess the performance of a variety of alloys in small experimental condenser configurations at seawater velocities of 10 to 20 fps are summarized. They demonstrate that the addition of 1% aluminum increases the maximum velocity limits of copper-nickel alloys to 12-15 fps. Stainless steels, nickel alloys, and titanium are satisfactory for use at velocities of 20 fps, but many of these would be susceptible to pitting and/or crevice corrosion under stagnant conditions.
W70-01721

CUPRO NICKEL ALLOYS FOR DESALINATION PLANTS,
American Brass Co., Waterbury, Conn.
D. M. McCue.
IN Proc Western Water Power Symp, Los Angeles, Apr 1968. Western Periodicals, North Hollywood, Calif, 1968. p C-88-89.
Identifiers: *Copper alloys, *Fabrication materials, *Nickel alloys, *Specifications, *Tubing (Metal), Condensers, Copper, Corrosion, Corrosion control, Hydrostatics, Nickel, Pitting (Corrosion), Stress corrosion.

Because of their resistance to corrosion in seawater and to stress corrosion cracking, the cupro-nickel alloys (with a little iron added to control pitting) are used for tubing in leading desalting processes. Performance requirements are exacting for desalting in that a 30-yr service life is desirable, but the pressure to which the tubes are subjected is less than 100 psig, thereby differing from power plant tubing requirements. Another point of difference is in length. Currently the longest tube lengths in use in power plants are only about 100 ft, while the desalting program envisions tubes exceeding 300 ft. In view of these differences, the OSW in 1965 instituted at ORNL a task group (with representatives from industry, copper development association, OSW and other interested parties) to formulate a set of specs differing from those in ASTM specification B 111 for copper seamless condenser tubes. The resulting proposed specifications cover both 90-10 and 70-30 cupro-nickel alloy tubes and contain chemical requirements more complete than those in ASTM B 111 in that total carbon, phosphorus and sulfur are named. Minimum tensile properties are set at 65,000 psi for 70-30 cupro-nickel and 50,000 psi for 90-10 cupro-nickel. The new specs call for eddy current testing instead of hydrostatic testing, as under ASTM spec.
W70-01727

THE CUPRO-NICKELS IN DESALINATION PLANT,
International Nickel Co., Ltd., London (England); and International Nickel Co., Inc., New York.
B. A. Weldon, and A. H. Tuthill.
IN Proc Western Water Power Symp, Los Angeles, Apr 1968. Western Periodicals, North Hollywood, Calif, 1968. p C-90-103, 1 fig, 15 ref.
Identifiers: *Copper alloys, *Fabrication materials, *Nickel alloys, *Tubing (Metal), Condensers, Copper, Corrosion, Corrosion control, Nickel, Pitting (Corrosion), Reviews, Stress corrosion.

A brief review of the properties of the most important alloys of the copper-nickel series, showing how they have been used in the past and discussing their corrosion behavior with particular reference to operation in large desalination plants. The alloys CF copper and nickel show mutual solid solubility throughout the whole range of composition, and thus all of them are basically ductile and corrosion resistant. However, two alloys at the copper-rich end of the range (90/10 cuni and 70/30 cuni) and one at the nickel-rich end (70-30 nicu) have proved to be particularly useful for desalting plant application. They have already been used extensively for tubes in both large desalting plants and in shipboard evaporators, and it is probable that they will be the first choice for plants now being designed, especially for the stages where corrosion conditions are most aggressive and also in many cases throughout the plant where long life and low maintenance are a prime consideration.
W70-01728

INVESTIGATION OF CORROSION IN HOT SEA WATER IN AN EXPERIMENTAL LOOP APPARATUS,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 03A.
W70-01755

CORROSION-RESISTANT COATINGS FOR WASTEWATER TREATMENT PLANTS,
Koppers Co., Inc., Pittsburg, Pa. Organic Materials Div.
For primary bibliographic entry see Field 05D.
W70-01993

09. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

PROGRESS IN SPORT FISHERY RESEARCH - 1968.
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Bur Sport Fish and Wildlife Resource Publication 77, May 1969. 259 p, 7 fig, 10 tab, 10 photo.

Descriptors: *Fisheries, *Sport fishing, *Ecology, Fish management, Fish conservation, Fish reproduction, Pesticides, Fish populations, Fish control agents, Reservoir fisheries, Stream fisheries, Marine fisheries, Lake fisheries.
Identifiers: *Sport fisheries research.

The research done in 1968 by the Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, is reviewed and summarized. Topics include ecosystem research, pesticide research, and fish husbandry research. A bibliography of work done by Bureau employees as well as translations and some reports by others is included. (Knapp-USGS)
W70-01883

10. SCIENTIFIC AND TECHNICAL INFORMATION

WATER AND LAND RESOURCES OF ARKANSAS,
Arkansas Soil and Water Conservation Commission, Little Rock.
Charles J. Finger.
Arkansas Soil and Water Conserv Comm Bibliogr Rep, June 1967. 90 p, 945 ref.

Descriptors: *Bibliographies, *Water resources, *Arkansas, Planning, Water management (Applied), Water resources development, Water pollution, Water supply, Groundwater, Surface waters, Water utilization, Climates, Drainage, Economics, Floods, Water chemistry, Aquifers, Irrigation, Land management, Limnology, Recreation, Water storage, Sedimentation, Soils.
Identifiers: Water resources bibliography.

As one of the first steps in the preparation of a comprehensive state water plan, the Arkansas Soil and Water Conservation Commission authorized the preparation of a bibliography of literature pertaining to water and related land resources of Arkansas. The material in the bibliography is arranged under subject-matter headings. Under each subject the material is listed alphabetically by author, from the earliest to the most recent date. Those references dealing with more than one subject are listed under the major subject and have not been cross-indexed. Many of the publications listed are available in a library maintained in the office of the Commission. (Knapp-USGS)
W70-01701

METROPOLITAN WATER RESOURCE MANAGEMENT AS AN EMERGING SPECIALIZED TECHNICAL AREA: A STATE-OF-THE-ART AND LITERATURE REVIEW,
Chicago Univ., Ill. Center for Urban Studies.
For primary bibliographic entry see Field 06B.
W70-01840

PROGRESS IN SPORT FISHERY RESEARCH - 1968.
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tions, Standing crop, Productivity, Fish, Fish management.
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